

Croatan National Forest

Land And Resource Management Plan



United States
Department of
Agriculture
Forest Service
Southern Region



The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communications of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964 (voice Or TDD). USDA is an equal opportunity provider and employer.

*Revised Land and Resource
Management Plan
for the
Croatan National Forest*



Carteret, Craven, and Jones Counties of North Carolina

Lead Agency:

USDA Forest Service

Responsible Official:

Bob Jacobs
Regional Forester
Southern Region
1720 Peachtree Road, NW
Atlanta, GA 30367-9102

For More Information:

John Ramey
Forest Supervisor
USDA Forest Service
National Forests in North Carolina
P.O. Box 2750
Asheville, NC 28802
828-257-4200

December 2002

This page intentionally left blank

Table of Contents

Chapter 1: The Need for Change	9
1.1: Description of the Croatan National Forest	11
1.2: History of Croatan	12
1.3: Relationship with Other Plans and Documents	14
1.4: Issues Discussed in this Plan	16
Biological Diversity:	16
Recreation Opportunities:	16
Special Land Allocations:	16
Silviculture, Forest Health, and Forest Products:	17
Fire Management:	17
Access:	17
Local Communities:	17
1.5: What is not Addressed in the Plan	18
1.6: The Remaining Chapters	18
Chapter 2: Forestwide Goals and Objectives	21
2.1: Biological Diversity	21
2.1.1: RECOVER RCW POPULATIONS	22
Background	22
Response to the Issue	23
2.1.2: IDENTIFY AND PROTECT SPECIAL INTEREST AREAS	23
Background	23
Response to the Issue	24
2.1.3: RECOVER AND SUSTAIN RARE SPECIES AND COMMUNITIES	24
Background	24
Response to the Issue	25
2.1.4: RESTORE OLD GROWTH FORESTS	25
Background	25
Response to the Issue	26
2.1.5: MAINTAIN BEAR HABITAT	26
Background	26
Response to the Issue	27
2.1.6: MAINTAIN HARDWOOD CYPRESS WETLANDS	28
Background	28
Response to the Issue	29
2.1.7: RESTORE HARDWOODS ON SUITABLE SITES	29
Background	29
Response to the Issue	30
2.1.8: RESTORE HYDROLOGIC FUNCTION & SUSTAIN AQUATIC ECOSYSTEMS	30
Background	30
Response to the Issue	30
2.2: Recreation Opportunities	31
2.2.1: INCREASE RECREATION OPPORTUNITIES	31
Background	31
Response to the Issue	31

2.2.2: EXPAND HUNTING, FISHING, & WILDLIFE-RELATED RECREATION OPPORTUNITIES	32
Background	32
Response to the Issue	32
2.3: Special Land Allocations	32
2.3.1: WILDERNESS	32
Background	32
Response to the Issue	33
2.3.2: RIVER CORRIDORS ELIGIBLE FOR WILD AND SCENIC RIVER STATUS	34
Background	34
Response to the Issue	34
2.4: Silviculture, Forest Products, And Forest Health	34
2.4.1: RESTORE LONGLEAF PINE	34
Background	34
Response to the Issue	35
2.4.2: SUSTAIN PINE STRAW PRODUCTION	35
Background	35
Response to the Issue	36
2.5: Fire Management	36
2.5.1: REDUCE WILDFIRE-RELATED RISKS	37
Background	37
Response to the Issue	37
2.5.2: EXPAND THE ROLE OF PRESCRIBED FIRE	38
Background	38
Response to the Issue	39
2.5.3: MAINTAIN AIR QUALITY	39
Background	39
Response to the Issue	40
2.6: Access	40
2.6.1: PROVIDE ACCESS WHILE PROTECTING NATURAL RESOURCES	40
Background	40
Response to the Issue	41
2.7: Local Communities	42
2.7.1: ADJUST LAND OWNERSHIP	42
Background	42
Response to the Issue	42
2.7.2: REGULATE SPECIAL USES	43
Background	43
Response to the Issue	43
2.7.3: CONTRIBUTE TO SUSTAINING LOCAL COMMUNITIES	43
Background	43
Response to the Issue	44
Forestwide Goals/Desired Conditions and Objectives per Issue	46
2.1 Biological Diversity:	46
2.2 Recreation Opportunities:	50
2.3 Special Land Allocations:	52

2.4 Silviculture, Forest Products, and Forest Health:	54
2.5 Fire Management:	56
2.6 Access:	59
2.7 Local Communities:	60
Chapter 3: Prescriptions: Management Of Key Landscape Features, Conditions, & Uses	63
3.1: Introduction	63
3.2: Pocosin Lake Management	64
3.3: Wilderness Management	65
3.4: River Corridors Eligible for Wild & Scenic River Status Management	67
3.5: Hardwood Cypress Wetland Management	68
3.6: RCW Habitat Management Area	70
3.7: Wildland-Urban Interface Management	73
3.8: Upland Hardwood Management	75
3.9: Black Bear Habitat Management	77
3.10: Developed Area Management	78
3.10.1: Recreation Sites in Rural Settings	78
3.10.2: Recreation Sites in Roaded Natural & Semi-Primitive Motorized Settings	79
3.10.3: Water-Based Recreation and Heritage Resource Interpretation	80
3.10.4: Impoundments	81
3.10.5: Administrative & Communication Sites and Special Uses	82
3.11: OHV System Management	82
Embedded Prescriptions:	83
3.12: Special Interest Areas Management	83
3.12.1: Natural Areas Management	83
Description of Designated Areas	85
3.12.2: Heritage Resources Management	90
Description of Designated Areas	91
3.13: Old Growth Forest Management	93
3.13.1: Descriptions of Old Growth Forests	95
Chapter 4: Standards – Forest-wide and Management Prescriptions	99
4.1 Soil, Water and Air	100
4.2 Wildlife, Fisheries and Botanical	102
4.3 Recreation	104
4.4 Silviculture	106
4.5 Fire	109
4.6 Transportation System	111
4.7 Special Uses	112
4.8 Lands – Land Ownership Adjustment	114
4.9 Heritage Resources	116
Chapter 5: Monitoring and Evaluation	117
5.1: Purpose of Monitoring and Evaluation	117
5.2: Levels of Forest Plan Monitoring	118
5.3: The Monitoring Plan: Five Categories of Questions	118
5.3.1 Monitoring Questions	119

5.3.1.1. Monitor MIS Population Trends and Habitats.....	119
5.3.1.2. Monitor Habitats Least Affected by Management Activities	119
5.3.1.3. Monitor Public Use and Consumer Satisfaction.....	120
5.3.1.4. Monitor Local Community Needs and Community Actions.....	120
5.3.1.5. Design and Implementation of Projects.....	121
5.4 Background Information for Monitoring.....	126
5.4.1 Baseline data for Monitoring Population Trends.....	126
RCW	126
Longleaf/Wiregrass.....	128
Wild Turkey	130
Black Bear.....	132
5.4.2 Background Information for Monitoring Habitats.....	134
5.4.3 Background Information for Monitoring Public Use and Customer Satisfaction.....	137
5.4.4 Background Information for Local Communities.....	138
References.....	139

Chapter 1: The Need for Change

This publication explains how the U.S. Department of Agriculture Forest Service proposes to manage the Croatan National Forest (CNF) over the next 10 to 15 years. Information is provided that describes what activities will be implemented and what public benefits are anticipated. The Forest and Rangeland Renewable Resources Planning Act of 1974, and the National Forest Management Act of 1976, require long-term planning of this kind. The new Plan revises and updates the Plan that was adopted in 1986.

The land management planning process prescribed in laws and regulations is complex and involves input from many different sources. To aid in understanding the planning process and the presentation of the management strategy, two steps have been taken to simplify the planning documents: (1) Details are provided in appendices in a separate publication; (2) A detailed Environmental Impact Statement (EIS) as a companion document is included.

In the time since the 1986 Land and Resource Management Plan for the Croatan National Forest was signed, the vision for the Forest has shifted to managing for healthy natural communities and processes, and providing for human uses and values within the context of sustainability.

The location of the CNF and its proximity to rapidly developing coastal communities stimulated a need for change from the direction in the 1986 Plan. The beaches and sounds of eastern North Carolina are less than a days drive from many large metropolitan areas, such as Washington, D.C., Baltimore, Philadelphia and New York City. Yet they retain a natural and unspoiled appearance that is often lacking in similar areas to the north in Virginia and to the south in South Carolina and Florida. It is not surprising, therefore, that people are buying land near water for vacation and retirement homes on the North Carolina coast. Construction of homes for recreation and retirement, and the seasonal influx of large numbers of people, will gradually begin to affect the character of eastern North Carolina.

In addition to land providing a place to build, forests in the area have been cleared for agriculture and plantation forestry. With proper drainage and management, eastern North Carolina's organic soils have proven highly fertile for row crops, and forest industries own large tracts on which they grow southern pines in plantations. Both activities are very important to the economy of the State, but both create ecological conditions considerably different from those in the original forests.

In formulating this Plan, it was realized that a high priority needed to be given to maintaining biological diversity and the appearance of natural forests, which are rapidly being altered on private land in the region. The CNF will increasingly be a special place where natural landscapes and natural processes dominate.

One of the most important biological needs to revise the 1986 Plan direction was to incorporate the latest requirements to maintain and enhance habitats for the federally endangered red cockaded woodpecker (RCW). The 1995 RCW Recovery Plan called for specific recovery objectives to be developed and included in revised forest plans.

Associated with recovery of the RCW was the need to develop an overall strategy for restoring the longleaf pine ecosystem on the Croatan National Forest. Past fire suppression and widespread planting of loblolly pine has greatly reduced the amount of longleaf pine habitat on the forest over the last 100 years. The longleaf pine ecosystem has been identified as critical to not only recovering RCW populations but also in maintaining and restoring other rare species associated with the longleaf pine-savanna ecosystem. Managing the herbaceous understory through a variety of means, including prescribed fire, has also been recognized for its importance in addition to managing the overstory of longleaf pine.

Another need for change was the growing understanding of the need for an expanded prescribed burning program, not only to restore the longleaf pine ecosystem and RCW habitat, but also to reduce fuel loading on the forest. A reduction in fuel loads is needed to lessen the likelihood of uncontrollable fires that pose an increasing risk to the rapidly expanding urban interface along the boundaries of the forest.

Plan direction also needed to be updated to reflect the increasing demands from local communities for primitive camping, water-based recreation, and other dispersed recreation opportunities on the forest. The forest also identified the need for new plan direction to respond to widespread and increasing unauthorized use of OHVs on the forest.

A new tool became available that needed to be incorporated into the revised Plan. An ecological classification system (Appendix A) was developed for the Croatan National Forest that provided a basis for ecologically based land management decisions. The ecological classification organizes the landscape into units having similar topography, geology, soil, climate, and natural disturbance regimes. The premise is that these factors provide the environmental conditions that dictate biological responses, site potentials, and site limitations. The linking of biotic and abiotic elements allows for prediction of species suitability and productivity, identifies physical limitations of sites and critical habitats for wildlife, and highlights unique features of the land that might have important recreation and scientific value.

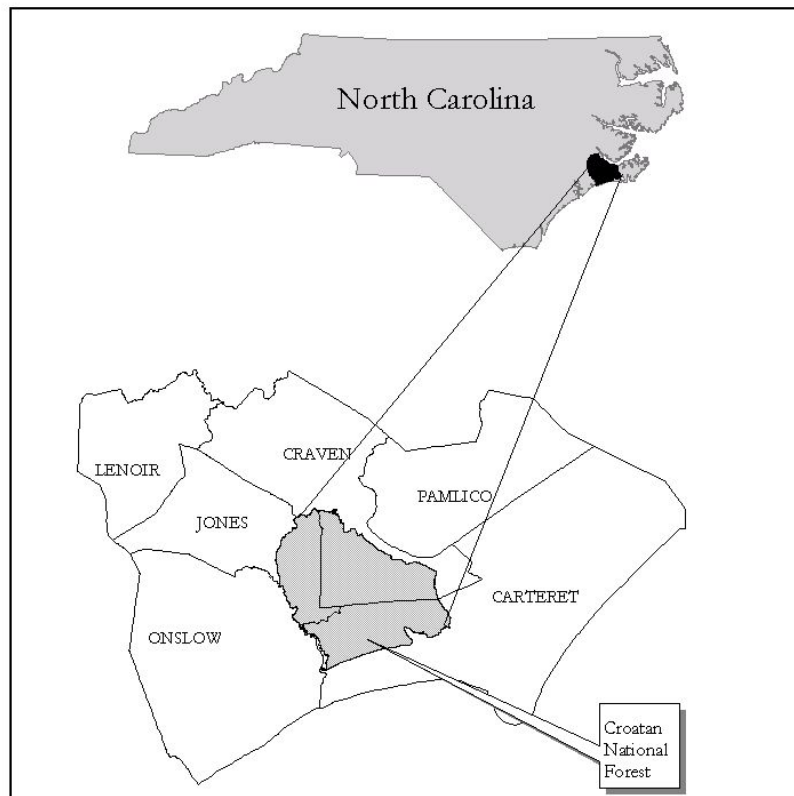
Several changes in national-level direction for the Forest Service needed to be incorporated into a revised management strategy for the CNF. These included the natural resource agenda and a new emphasis on science-based planning and management. The natural resource agenda includes the following commitments: 1) to restore and maintain healthy watersheds; 2) to sustain forest resources for present and future generations; 3) to manage roads compatible with natural resource uses while providing access to users; and 4) to increase recreation opportunities. The emphasis on science-based planning and management includes an understanding of the structure and function of landscapes at various scales, and the implications of changing landscapes on human and ecological

communities.

At various stages in the planning process, comments and ideas have been requested and received from individuals and organizations that are interested in the CNF. The Plan's publication gives everyone the opportunity to see how issues that surround management of this national forest in eastern North Carolina are resolved.

1.1: Description of the Croatan National Forest

The CNF is located on the eastern coastal plain of North Carolina. It covers small portions of three counties: Craven, Carteret, and Jones. The CNF is relatively small in comparison to other national forests, covering only about 161,000 acres. The forest's unusual biological features, topographic features, and location on the Atlantic Coast, however, make it far more interesting and important than its acreage might suggest.



Perhaps the most interesting topographic features are the pocosins that occur at the upper rather than the lower end of the drainages. The pocosins are concentrated at the center of the CNF. In low pocosin, tree growth is extremely slow, because of the low oxygen and nutrient contents of the soil. Mature trees may be only 4 to 6 feet tall. The brushy pocosin vegetation is nearly impenetrable, so it provides cover as well as food for black bears.

A few miles to the south of the central lakes and pocosins are sandy ridges that support

old and very large longleaf pines, which have become rare in much of the South. The scarcity of mature longleaf pines does much to explain the endangered status of the red-cockaded woodpecker (RCW), which is an important resident of the CNF. The longleaf pine-wire grass ecosystem is globally rare and currently represents only 3% of the historical range for the ecosystem.

Nearer the edges of the CNF are hardwood wetlands that follow meandering, sluggish streams. Huge baldcypress trees are in these wetlands, providing habitat for songbirds like the prothonotary warbler. This area is also habitat for alligators.

Its special landscape features and the species they support make the CNF one of America's most valued forests. This plan outlines a strategy for conserving its treasures while allowing visitors to enjoy them wisely.

1.2: History of Croatan

Native American occupation of the coastal plain in North Carolina extends back as much as 14,000 years. These first occupants were hunters of large mammals, including mammoths and bison. At that time, glaciers still occupied much of North America, and sea level was considerably lower than it is today. Because the climate and water level were different, the vegetation also was considerably different. Hardwood replaced pine and spruce forests as glaciers retreated due to warmer climates.

The Woodland Period, which began 3,000 years ago and extended through settlement by Europeans, is of particular interest for management of the CNF, because archeological sites from this period are present. Permanent villages were located along drainages, and fishing and shell fishing were common activities. Shell refuse piles or "middens" are present in the CNF.

Prior to English settlement of North Carolina, Spanish navigators returning home from the Caribbean rode the Gulf Stream northward until in sight of Cape Hatteras then turned eastward. Between the Outer Banks and the mainland are five sounds -- Currituck, Albemarle, Pamlico, Core, and Bogue. Their shallow depth and shifting shoals make these sounds dangerous for navigation. Major rivers flow into these sounds and exit through a series of inlets that also shift. Shifting ship channels, swift ocean currents, and the periodic occurrence of powerful storms have combined to make the North Carolina Outer Banks the "Graveyard of the Atlantic."

Settlement of North Carolina was hampered by the almost continuous barrier of islands or banks that stretch 335 miles from Cape Henry in Virginia to Cape Fear in North Carolina. The first effort at English colonization in North America, sponsored by Sir Walter Raleigh, was attempted on Roanoke Island, North Carolina, in 1585. The grand intentions for settlement were poorly conducted, leading to the disastrous failure of the "Lost Colony."

European settlers migrated south from Virginia at the start of the 18th century. A small

colony of French settlers was in the area when the Swiss founded the town of New Bern in North Carolina (Lefler 1967). Near New Bern is Brice Creek, which was named after William Brice, who was in the area by 1702 (Dill 1974).

During the colonial period, forest-related industries were more important than agriculture for North Carolina's cash economy. Colonists raised crops for their own consumption, but the primary exports were naval stores—tar, pitch, and rosin for ships. North Carolina was Britain's main supplier of these products. With little investment, a person could gather and process naval stores, and many did so, earning the nickname “tar heels,” still given to the State's residents. Commercial fishing, whaling, and ship and boat building were also important industries.

Trees were cleared for agriculture and to obtain wood for buildings and ships, but logging did not become a major industry in eastern North Carolina until late in the 19th century. At that time, the timber in the Lake States was being exhausted, and the national timber industry moved to the South to exploit its forests. On the coastal plain, they took mainly longleaf pines.

National forests were established in the South primarily on land that was cut over during the great logging boom. Efforts to reforest the land were successful, but loblolly pine was favored over longleaf pine in plantations, because its seedlings were easier to raise in nurseries and plant in the forest. One result was a huge decline in the acreage of the longleaf pine ecosystem, which once dominated the southern coastal plain.

The Croatan National Forest began with the New Deal Programs initiated during the Great Depression. These programs were designed to remove submarginal land from crop production and convert it to timber production. Due to agricultural use and abandonment, many acres were available in the tidewater region of North Carolina. Under the provisions of the Weeks Act of 1911 and the Clark-McNary Act of 1924, the Forest Service was given the authority to acquire land needed for timber production as well as protecting flows of navigable streams. In 1936, President Franklin D. Roosevelt created the CNF.

The local economy in the three-county area of the Croatan National Forest historically was centered on agriculture. With the commissioning of Marine Corps Air Station Cherry Point in 1942, the military began to gradually dominate the local economy. Today, MCAS Cherry Point employs approximately 7500 Marines and sailors, along with 5700 civilian employees, providing more than \$480 million a year to the local economy. The salaries, combined with local expenditures for supplies and capital improvements, totals more than \$610 million in economic impact in the state annually (MCAS Cherry Point 2002).

In recent years, manufacturing in service sectors of the local economy has grown rapidly. Manufacturing employment within Craven County is expanding at twice the average rate for the rest of the state. Jones County remains primarily rural, but Carteret and Craven Counties have rapidly growing travel and tourism industries.

1.3: Relationship with Other Plans and Documents

Management of the Croatan National Forest is influenced by policies and direction issued for National Forests in the southeast, as well as other lands adjacent to, and in the area of, the CNF. This interaction emphasizes the need to seek collaboration on mutual interests when managing natural resources. Some of the more pertinent plans and direction are listed below with a brief summary of each.

Final EIS for the Red-Cockaded Woodpecker & its Habitat on National Forests in the Southern Region

In 1995, the Forest Service developed a comprehensive management strategy to reverse the decline of RCW throughout national forests in the South. Over 50 percent of known RCW occurrences are on national forests. The standards in the Final EIS provide for the recovery of RCW and protect the long-term health of southern forests. The RCW-EIS identifies requirements for plan revisions. Over 37 pages of standards in the RCW-EIS set management direction for RCW habitat on the CNF.

Final EIS Vegetative Management in the Coastal Plain/Piedmont as supplemented

In 1989 the Southern Region of the Forest Service developed an analysis of effects of vegetation management methods. The five methods evaluated by the EIS are prescribed fire, mechanical, manual, herbicides, and biological. The decision prescribes the use of these methods and provides management requirements and mitigation measures for their use. In October 2002, the Regional Forester supplemented the original EIS and amended the forest plans clarifying direction for conducting project-level inventories for Biological Evaluations on those projects covered by the Vegetation Management EIS.

Integrated Natural Resource Management Plans for Marine Corps Base (MCB) Camp Lejeune and Marine Corps Air Station (MCAS) - Cherry Point

In 2001, Integrated Natural Resource Management Plans (INRMP) were completed and signed in support of management on MCB Camp Lejeune in Jacksonville, NC and MCAS Cherry Point, in Havelock, NC. MCB Camp Lejeune and the Croatan National Forest share responsibility for reaching the recovery goal established for the RCW. During development of this Plan and the INRMP for Camp Lejeune, the interdisciplinary teams collaborated on approaches to longleaf restoration, prescribed fire, and site preparation. Many of the approaches outlined in this Plan are also being practiced on Camp Lejeune.

MCAS Cherry Point and the CNF share similar boundaries, forest users, and management concerns. Approaches to management were shared between the Croatan National Forest staff and the managers of Cherry Point. Future collaboration efforts are supported by both agencies.

The Southern Forest Resource Assessment

The Southern Forest Resource Assessment (SFRA) documents and analyzes the forests of 13 Southern States. For the CNF, the significance of the SFRA lies in its inclusion of

three rare forest types—pocosins, longleaf pine ecosystems, and Atlantic White Cedar Swamps. Conservation of ecosystems is important to the overall biological diversity of the CNF as well as the entire region.

A Comprehensive Conservation & Management Plan (1993), Albemarle-Pamlico Region

Sponsored by the Environmental Protection Agency and the NC Department of Environment and Natural Resources, the Albemarle-Pamlico Estuarine Study (APES) provides the context of an eco-regional analysis. Some elements that affect the CNF are water quality, rare plants and natural communities, and stewardship. The CNF could help develop or maintain plans to protect water quality, rare plants and communities, as well as support nature-based tourism and environmental education as ways of fostering sound economic environments.

White Oak River Basin-wide Water Quality Management Plan (November 2001)

The White Oak Basin is one of sixteen basins for which Water Quality Management Plans have been prepared by the NC Department of Environment and Natural Resources. Goals of this plan include: identify and restore full uses of impaired waters, identify and protect high-valued waters, and manage problem pollutants.

Craven County, NC. 1996 Land Use Update

The Craven County Land Use Plan was certified by the Coastal Resources Commission in 1994 and updated in 1996. The greatest change in land use in the county resulted from real estate subdivision developments. From 1987 to 1992, 141 subdivisions (2,074 lots) were approved. In 1993, 43 subdivisions (340 lots) were approved. Housing units increased twice as fast as the population between 1980 and 1990. Over the last 20 years, mobile home developments increased by 190 percent. This trend of development creates significant wildland-urban interfaces with the CNF.

Carteret County, NC. 1996 Land Use Update

The Carteret County Land Use Plan was produced in 1996 in accordance with the requirements of the North Carolina Coastal Area Act (CAMA). The Plan was adopted by the Carteret County Board of Commissioners, and certified by the Coastal Resources Commission in late 1999. The County's population grew 79% in the years between 1970 and 1994. However, the peak seasonal population grew at a rate almost six times that of the permanent population from 1970-90. The high influx of seasonal people strains the local infrastructure, and creates increased demand for recreation. Though the economic benefits of seasonal visitors garners local support, it creates the need for a delicate balance between protecting and supplying access to the resources that draw people to the area.

Global Transpark Development

To compete with other States in economic development, the State of North Carolina created and funded regional development commissions in 1993. By 1995, seven regional commissions were serving all 100 counties and sharing over \$4.5 million of appropriated funds. The counties surrounding the CNF are part of a 13-county Global Transpark

Development Commission. The Commission's goal is to identify, improve, and effectively market the resources of this diverse region to attract new and expanding industry. In 1995, the commission began to make loans, grants, and environmental grants to upgrade infrastructure and acquire land.

1.4: Issues Discussed in this Plan

A primary purpose of national forest planning is resolving issues about which the public or forest managers are most concerned. Issues about management of the CNF were ascertained through written communications and through three public meetings in 1996. Seven issues were identified: biological diversity; recreation opportunities; special land allocations; silviculture, forest health, and forest products; fire management; access; and local communities. This Plan describes how, in the next 10-15 years, the Forest Service proposes to resolve or address these issues. Additional alternatives that were considered for addressing these issues are described in the companion EIS. The analysis for the Plan focused on answering key questions associated with each of seven issues.

Biological Diversity:

Biological diversity refers to the variety and forms of life and its processes. Biological diversity on the Croatan is extensive and complex due to the unique ecosystems present in the Atlantic Coastal Plain. While recognizing the complexity of biological diversity, and the vast levels or scales at which to consider species and ecosystems, what should this Plan focus on to maintain biological diversity on the CNF?

Recreation Opportunities:

Settings for the types of nature-based recreation enjoyed on national forests range from primitive to highly developed. Desires of traditional local users of a forest often differ from those of new recreationists attracted by a growing tourism industry. Is the mixture of recreation settings currently provided in the CNF meeting local as well as tourist demands? To what extent should recreation opportunities focus on hunting, fishing and other wildlife-related activities? What location can be used by off-highway vehicles without extensive damage to other natural resources?

Special Land Allocations:

Land on the CNF has been, and could be, allocated for wilderness, wild and scenic rivers, research natural areas, and special interest areas. Congressional designation is required for wilderness and wild and scenic rivers. Designation of research natural areas and special interest areas is an internal agency decision. Since allocation of an area for one of these purposes may preclude its use for certain other purposes, special allocation must be done with great care. The extent to which currently designated wilderness will be expanded needs exploration. Additionally, recommendation of the White Oak River and Brice Creek as wild and scenic rivers depends on the resource values present, the amount of local public and political support, and the extent of National Forest land bordering the corridors of the waterways. How should the Forest Service manage these areas to retain the unique values inherent to their potential designation whether official recognition

occurs or not? How should the Croatan Wildernesses be managed to best maintain the attributes of natural integrity, solitude, primitive recreation, and the wildernesses' value for scientific research, interpretation, and ecological function in the long term?

Silviculture, Forest Health, and Forest Products:

Concerns about ecosystem health, biological diversity, and rare species and communities have created demands to change existing forest types. Re-establishment of longleaf pine appears to be necessary for red-cockaded woodpecker recovery in the area, and some clearcutting and seedling planting may be needed to accomplish this objective. However, public opinion is divided on the idea of clearcutting loblolly pine and planting longleaf pine. What land is suitable for timber production on the CNF? The regulations require such a determination.

Fire Management:

Historically, fire has been one of the primary natural disturbances to the ecosystems of the CNF, and therefore plays a vital role in the management of these ecosystems. Fire also helps to limit hazardous levels of fuels. Natural ignition, i.e. lightning strikes, of fire is fairly common in the Coastal Plain. Research results are varied concerning human use of fire although it is commonly accepted that fire was used historically to modify vegetation, and its use continued long enough to have an effect on species composition and arrangement.

Questions surrounding the appropriate use of prescribed fire need to be addressed. How much prescribed fire will reduce the risk of wildfire in wildland-urban interface areas? What other treatments may need to be used to reduce fuel loading to a safe level before prescribed fire can be used? Where and under what circumstances should lightning-caused fires be allowed to burn, particularly in wilderness? What is the optimum amount and timing of prescribed burning that is needed to meet vegetation and wildlife management goals? If prescribed fire is increased, how will air quality standards be maintained?

Access:

Balancing reasonable public access with protecting the natural resources is a critical challenge for national forest management. Too much access has caused problems with trash dumping, unregulated shooting, user conflicts, negative impacts to wildlife, unauthorized use of closed roads, resource damage, and unauthorized, user-created trails and roads. High levels of access also increase the cost to maintain roads to an adequate and safe standard. However, limiting access too much restricts the public from through roads, and from using the national forest in ways that they enjoy such as biking, hunting, bird watching, OHV-riding, and camping. What is the best balance between resource protection and public access?

Local Communities:

The Croatan National Forest comprises approximately 14.6% of the land base of the 3 counties in which it exists. Managing this much of a county's land base requires close

contact with the local communities and governments. The interactions between the Forest Service and local communities can include issuing special use permits, providing forest products in support of local economies, exchanging or acquiring land, assisting with designations of unique areas or attributes, fire prevention, addressing mutual land management concerns, and supporting tourism opportunities. As the local communities grow, opportunities for collaboration and partnerships grow. The diverse population dynamics of the local communities surrounding the CNF present a challenge in developing collaborative partnerships. Many long time residents are still in the area, but an infusion of new residents, both seasonal and retirees, along with the transient population at MCAS Cherry Point, create a need for these new residents to develop connections to the CNF. Providing for compatible and complementary uses and values is essential for forest sustainability and community vitality. What opportunities exist for enhanced collaboration with and continued support for local communities?

1.5: What is not Addressed in the Plan

Minerals were not found to be an issue in this Plan. Limited potential exists on the CNF for the discovery of common variety minerals such as petrified wood, stone, pumice, cinders, clay, sand, and regulate. No leasable minerals, such as oil, gas, coal, phosphate, sodium and potassium, are known to occur on the CNF. Hard rock minerals are not produced on the CNF due to low potential for discovering an economic deposit. Hard rock minerals are generally called metals, precious metals, or industrial metals. Given these situations, the availability of national forest land for leasing or mineral development was not studied.

Should a mineral project be proposed, it would comply with standards in this plan, the National Environmental Policy Act, and other laws and regulations governing the management of national forest system lands and minerals.

1.6: The Remaining Chapters

The remainder of this publication describes management of the CNF at a variety of levels. Chapter 2 provides background information on each issue, along with the responses to the issues. Chapter 2 also describes the overall goals and objectives for the Croatan National Forest, and how they will be applied to the landscape as a whole.

Chapter 3 is written at the level of the individual landscape and of the features in that landscape. It is meant to clarify what conditions and uses the Forest Service proposes to allow on the ground. For each landscape feature a desired or “reference” condition is provided. These reference conditions are meant to clarify the vision to which management will be focused. Also described are management actions that may be prescribed.

Chapter 4 presents all of the standards to which managers must adhere to legally and successfully implement this Plan. The standards are presented by program area, at both

the forest level and management prescription level.

Chapter 5 presents the monitoring questions to be answered as the Plan is implemented. Since it is costly to monitor, priorities are established for answering these questions.

The appendices contain more detailed information used to develop the Plan, along with many helpful tools that will be used by managers of the Croatan National Forest for implementing this Plan.

This page intentionally left blank.

Chapter 2: Forestwide Goals and Objectives

This chapter outlines the strategy the Forest Service is proposing for the CNF as a whole. When the CNF is viewed as part of the Southeast, certain conclusions seem obvious, such as longleaf restoration and RCW management. Those conclusions led to the major directions of the plan.

This chapter is organized around the seven major issues that were identified with the help of the public. The chapter provides background information on each issue, along with a response to the issue. The response outlines how the issue will begin to be resolved in the next 10-15 year period of time. The chapter also describes the overall goals and objectives for the Croatan National Forest, and how they will be applied to the landscape as a whole. The goals and objectives indicate where time and resources will be invested to improve the natural and human environment in response to the issues identified.

2.1: Biological Diversity

To maintain biological diversity on the CNF, the Plan uses a “coarse filter/fine filter” approach, similar to the Nature Conservancy (Jenkins 1985, Noss 1987). These “filters” are designed to capture elements of biological diversity at various levels of organization. The coarse filter focuses on protecting landscape and ecosystem diversity and therefore groups of species. By identifying and protecting the best examples of all ecological communities, coarse filters assure the conservation of most species, biotic interactions, and ecological processes. The CNF coarse filter includes land allocations designed around Special Interest Areas, old growth forests, hardwood-cypress wetlands, and the RCW Habitat Management Area.

The fine filter focuses on protecting genetic and species diversity by identifying and protecting viable populations of species or subspecies that “fall through” the coarse filter (Jenkins 1976, Hunter 1991). These species are generally considered rare species and may be federally listed as threatened or endangered, or listed by the USFS as sensitive or locally rare. They are given protection under the Endangered Species Act and National Forest Management Act. Biological evaluations are conducted for all proposed projects to determine site-specific effects to these species, and activities are designed to avoid or lessen impacts.

Several elements of biological diversity are identified on the CNF. The first element is related to the recovery of the endangered red-cockaded woodpecker, and restoration of its native habitat. The second and third elements, ‘identify and protect Special Interest Areas’ and ‘recover and sustain rare species and communities’, support the recovery of the RCW, and consider other rare species and communities that occur on the CNF. The second element also addresses the identification and protection of Special Interest Areas, and designation as a means of managing multiple levels of biological diversity. The fourth element relates to old growth, and how it functions to support biological diversity.

The next three elements of biological diversity on the Croatan National Forest relate to wildlife conservation. Specifically, the fifth element addresses the maintenance of black bear habitat. Bears require large tracts of land, linkages between patches of suitable habitat, hard mast foods, and freedom from motorized disturbances. Suitable habitat for black bears is declining in the lower coastal plain of the South. Since hardwood cypress wetlands provide habitat for declining neotropical migratory birds as well as other species, this is the sixth element identified. The seventh element addresses the restoration of hardwoods in areas that historically supported this type of ecosystem.

The eighth element of biological diversity relates to the extensive amount of water and wetlands present on the Croatan National Forest, and the vast degree of biological diversity supported by properly functioning hydrologic and aquatic ecosystems.

2.1.1. RECOVER RCW POPULATIONS

Background

Longleaf pine forests capable of supporting the red cockaded woodpecker (RCW) once occupied up to 90 million acres in the South (Wahlenberg 1946, Frost 1993). In 1985 less than 4 million acres remained (Kelley and Bechtold) and the best estimate today is less than 3 million acres. When forest resources were depleted in the Great Lakes region, forest industry moved South to purchase newly available Federal land for as little as \$1.25 an acre. Large-scale commercial logging began in the South in the 1880s. (Lillard 1947).

The logging slash left behind fueled large forest fires, which triggered an extensive and successful fire suppression campaign. Fire control led to further reduction in longleaf pine because hardwoods were quick to invade these fire-protected pine sites. On the CNF, longleaf pine now occupies less than 30 percent of its original presettlement range (Frost 1996).

The decline of the RCW, formerly common in the South, can be linked directly to habitat losses associated with the reduction of old southern pines. Their exclusive use of living pines for cavities is apparently an adaptation to the fire climax pine ecosystem of the South, where dead snags are rare because of frequent fires (Jackson and others 1986; Ligon 1970). Old pines are preferred for cavity trees because their fungus-decayed central heartwood allows for easier cavity excavation (Jackson 1977, Hooper 1988). Although cavity excavation time is typically shorter in other species of pine, longleaf pine makes a better cavity tree since it is a very long-lived species, and can be used much longer than other pines (Conner and Rudolph 1995).

The RCW was listed as a federally endangered species in 1970, and a recovery plan for the species was completed in 1985. Twelve of the 15 populations identified in the recovery plan are supported with nesting and forage habitat totally or in part on national forests. The CNF shares 1 of these 12 recovery populations with Marine Corps Base Camp Lejeune and Holly Shelter State Gamelands.

Since 1992, the CNF has been following a plan to link its fragmented RCW population. The plan emphasizes cavity drilling to attract new RCW breeding groups to existing unoccupied clusters and to newly created clusters. The plan also includes burning and roller chopping to control the hardwood midstory in certain areas.

Since the 1992 plan was initiated, the RCW population on the CNF has increased from 44 to 64 clusters, a growth rate of 10 percent per year (Walters 1997). Furthermore, the overall population number has more than doubled. This increase was accomplished not by moving birds from elsewhere in the CNF, but by managing the existing population and habitat. However, following hurricanes between 1996 and 1997 the population declined, and although by 2001 it returned to pre-hurricane levels, the growth rate has remained relatively static.

Response to the Issue

Follow RCW management direction in the 1995 RCW FEIS to evaluate RCW viability and demography on the CNF. Establish a RCW habitat management area that is primarily a forest of longleaf pine and mixed pine savannas and determine a long-term population objective for the area. Through joint efforts with MCB Camp Lejeune and Holly Shelter State Gamelands, recover a viable population of RCW using the knowledge gained from the Forest's past RCW activities, along with strategic longleaf pine restoration, midstory control and an expanded use of fire. The goals and objectives in this Plan update the 1992 RCW Plan. See Table 2.1 for RCW goals and objectives and Table 2.4 for longleaf restoration goals and objectives, and Table 2.5 for fire management goals and objectives.

2.1.2: IDENTIFY AND PROTECT SPECIAL INTEREST AREAS

Background

The Southern Coastal Plain contains some of the most diverse ecosystems in the temperate zone of the United States. These ecosystems support numerous plant and animal species, many of which are considered globally rare and of national significance. Data collected by State Natural Heritage Programs across the Nation show that some 9,000 United States plant and animal species are rare, seriously declining, and/or likely to be at risk of extinction in the future (Biological Conservation Database, 2000).

This trend is especially notable in the Southern Coastal Plain, where expanding human populations have resulted in rapid changes in land use. Public tracts, such as the CNF, are the few remaining unfragmented areas large enough to contain ecosystems that can support a wide variety of native plant and animal species. Furthermore, management of National Forest System lands is not driven by commodity production but mandated to provide a mix of conditions, and human uses compatible with native ecosystems, natural processes, and inherent land capabilities (Multiple Use Sustained-Yield Act of 1960).

The Forest Service has a national policy to manage habitats for plant and animal species to prevent rare species from being federally listed under the Endangered Species Act. The sensitive species program, the agency's early warning system, focuses management attention on ecosystem components that are rare, fragile, or in decline. On the CNF,

approximately 56 rare species and 24 rare plant communities that support these species would meet these criteria.

On the CNF, 11 Registered Natural Areas, comprising 42,000 acres, have been managed for their unique ecosystem values since 1986. In 1995, the North Carolina Natural Heritage Program (NCNHP) proposed 18 additional natural areas for registration on the CNF. In combination, registered and proposed natural areas would total approximately 66,000 acres or over 40 percent of the CNF. The predominant management recommended for these areas by the NCNHP is protection. Many of these areas are located where unique plant communities occur and in habitats that are rare, fragile, or in decline and where species diversity is high. They could provide a coarse filter approach to species conservation because they capture diversity at the landscape and community level as well as species level. In this approach, ecosystem elements and processes are maintained by providing ecological conditions suitable for a wide variety of species.

Response to the Issue

Designate Special Interest Areas (SIA) where species and community diversity is high based on the natural areas identified by the North Carolina Natural Heritage Program and rare species element occurrences. Determine the number of proposed Special Interest Areas in combination with other ecosystem-based management prescriptions that could capture, within a coarse filter, the greatest number of rare species and fragile ecosystems. These areas should be representative of the full range of environments found on the CNF, and should be recognized as core areas for rare species and unique communities. Limit logging and road building in these areas, except where management for a federally threatened or endangered species is necessary (e.g. RCW). Allow natural disturbances such as lightning-caused fires to function as much as possible as natural processes. Table 2.1 lists goals and objectives for identifying and protecting SIAs.

2.1.3: RECOVER AND SUSTAIN RARE SPECIES AND COMMUNITIES

Background

The Forest Service is cooperating nationally with other government agencies to conserve rare species by protecting and managing their habitats and ecosystems. Conservation priorities and management intensity levels are based upon species vulnerability. Species are assigned to categories of endangered, threatened, proposed, sensitive, or locally rare according to their risk of extinction or extirpation.

Proposed, endangered, and threatened species are those at the greatest risk of extinction. They are federally listed species and are regulated by the Endangered Species Act of 1973 (as amended), which requires that “all Federal departments and agencies...seek to conserve endangered and threatened species, and the ecosystems upon which they depend.”

Sensitive species are at risk of extirpation (risk of extinction in a portion of their range), as evidenced by downward trends in population numbers or density, or downward trends in habitat capability. They are listed by the Regional Forester and their management is guided by standards in Forest Service Manual 2670. Supervisors of individual national

forests are directed to maintain the viability of sensitive species and ensure they do not trend toward Federal listing.

Locally rare species are not at risk of extinction and do not show downward trends in population numbers over their range as a whole. They are, however, uncommon on a national forest planning area and add to the diversity of species found there. They are listed by individual national forests and usually also by State agencies. Management of locally rare species is focused on maintaining their representation within a forest to provide for a diversity of plant and animal communities as required by the National Forest Management Act.

Four federally endangered or threatened species, 17 sensitive species, 36 locally rare species, and 24 rare plant communities occur on the CNF. Based on surveys during the last 40 years, 387 occurrences of these species and communities have been documented on the CNF. Most of these occurrences are located within Special Interest Areas (SIA), old growth longleaf pine stands in the RCW HMA, and in other management prescriptions not suited for timber production. Because these areas are managed to maintain natural conditions in a mixture of habitats representative of most environments in the Coastal Plain, they act as a coarse filter to capture most of the species and community diversity found on the CNF. This approach to species conservation would provide suitable habitat conditions in management areas not suited for timber production for about 57 percent of all the sites where endangered, threatened, sensitive, and locally rare species occur and 77 percent of all sites where rare communities occur on the CNF. The remaining rare species and rare community element occurrences are in a portion of the RCW HMA that is suited for timber production. These areas could potentially be impacted by vegetation management activities. These populations may be critical for maintaining species viability on the CNF.

Response to the Issue

Identify population objectives for TES and sensitive species, and conservation objectives for rare communities and locally rare species that should be maintained on the CNF. Monitor the condition of rare species element occurrences and provide management direction to maintain habitat conditions for species that are now locally rare or extirpated, but may become reestablished on the CNF if suitable habitat exists. Table 2.1 shows goals and objectives for recovering and sustaining rare species and communities.

2.1.4: RESTORE OLD GROWTH FORESTS

Background

Old growth occupies only 0.6 percent of the total forest acreage in the Southeast (Davis, 1996). In the Croatan area, widespread logging, farming, and land clearing during European settlement transformed the presettlement forests to agriculture, disturbance vegetation, and fire-suppressed successional forest. Much natural vegetation and structural diversity was lost because of past human disturbance and 20th century fire suppression.

The term “old growth” is used to describe relatively undisturbed, old forests. The

dominant trees that are best adapted to the site have grown beyond average life expectancy for the species. The stands have a significant number of trees with large diameters, and in old growth pine species the crowns are flattened. Standing dead or down trees are also present.

The Forest Service recognizes old-growth forest as a valuable natural resource worthy of protection, restoration, and management (USDA Forest Service, 1989, 1997). Old growth provides a variety of significant values, such as biological diversity, wildlife and fisheries habitat, recreation, aesthetics, water quality, cultural values, and high-value timber products.

As a whole, the CNF currently has a substantial amount of hardwood forest, swamp forest, and loblolly pine, but pond pine and longleaf pine were the two dominant tree species in pre-settlement forests (Frost 1996). Less than 400 acres of old-growth longleaf pine forest remains on the Croatan, occurring in isolated stands in the central part of the forest. These stands represent less than 1 percent of all sites suitable for longleaf pine. A few locations on the CNF have primeval cypress or hardwoods. These remnant trees, passed over in logging due to their poor wood quality, do not, by themselves, represent old-growth forests. A majority of the pond pine forest, however, occurs as older stands approaching an old-growth condition.

Response to the Issue

Identify the major plant community groups on the Croatan that can function as wildlife habitat, have high biological diversity, and can provide scientific, recreational, and other social values. These should include: (1) coastal plain upland mesic hardwoods; (2) cypress-tupelo swamp forests; (3) upland longleaf forests; and (4) southern wet pine forest (i.e. pond pine), woodlands, and savannas. Map the oldest stands representing plant community groups that occur within areas suited for timber production. For plant community groups that occur in areas not suited for timber production, determine the proportion of stands that should remain in old-growth condition across the Croatan. Designate this network of older forests for management as old growth and restrict use to provide old-growth stand conditions. Table 2.1 lists goals and objectives for restoring old growth forest.

2.1.5: MAINTAIN BEAR HABITAT

Background

As a result of extensive habitat alteration over the last 100 years, it is estimated that by the 1980s, black bears occupied only 5-10 percent of their historic range in the Southeastern United States (Maehr 1984, Pelton 1986). Black bear populations in southeastern wetlands are threatened by habitat destruction and fragmentation on dwindling tracts of private land. Pockets of wetland habitat, such as swamps and pocosins, provide the last remaining refuges for black bears in the Atlantic Coastal Plain. Black bear populations generally tend to be found in remote tracts of public forestland.

After reaching a low in the mid 1970s, black bear population trends have been steadily increasing in the Coastal region of North Carolina. The population began to stabilize in

the mid to late 1980s. Within the counties that contain the Croatan National Forest, harvest levels have been increasing, indicating an upward trend in the black bear population (NC Wildlife Resources Commission Performance Reports for Black Bear, 1999-2001). Maintaining habitat on the Croatan National Forest will help to ensure that the population trend for black bears remains steady.

Numerous research studies have documented that a variety of habitats are needed to fulfill bears' food and cover requirements throughout the year. In a study conducted in southeastern North Carolina, Landers, and others (1979) listed the following as the major black bear habitat components: (1) a variety of habitats producing seasonal foods, (2) extensive inaccessible areas for denning, and (3) escape cover for bears hunted with dogs. Landers and others also recommend that management plans for Coastal Plain bear populations should include guidelines to maintain and enhance stands of mature gum and oaks, swamp tupelo, shrub and vine mast (primarily *Illex* spp. and greenbriar fruits), pocosins, and forest openings (such as roadside margins and recent burns). Maintenance of mature, mast-producing stands is a critical need for black bears in the Atlantic Coastal Plain (1979).

A recent study in Great Dismal Swamp National Wildlife Refuge documented the importance of pocosin species for Coastal Plain bear populations. Active management is necessary to maintain productive pocosins for black bears. Prescribed burns, small clearcuts, or drum chopped areas are necessary to mimic natural disturbances (Hellgren 1988). In addition, management of roadside strips for blackberries and other roadside plants by mowing every 3 to 4 years provides important seasonal soft mast. However, bears generally avoid often-used roads in harvested areas.

A regional assessment of remote forests and black bear habitat in the Southeast conducted by Rudis and Tansey (1995) concluded that black bear conservation strategies must involve three major elements: (1) retaining areas of remote forests, (2) restoring optimal habitat by increasing reserved timberland and reforestation of bottomland hardwood timberland, and (3) increasing optimal habitat connections between occupied and potential habitat blocks.

Controlling access into bear habitat, particularly on large tracts of public land, is imperative (Hillman and Yow 1986). Relatively large, nearly impenetrable bays and swamps provide seclusion and protection from disturbance during denning (Landers and others 1979). Limiting open roads would be potentially beneficial to black bears. Feeding grounds and travel corridors occur along closed roads and roadside margins.

Response to the Issue

Manage black bear habitat to allow unobstructed movement of black bears across the CNF. Maintain a variety of habitats that produce forage for black bears. Minimize human disturbance and modification of black bear habitat, except where it is necessary to manage the habitat using tools such as prescribed burning. Provide landscape linkages to potential foraging areas on public and private land through a system of hardwood cypress wetland corridors. Table 2.1 shows goals and objectives for maintaining bear habitat.

2.1.6: MAINTAIN HARDWOOD CYPRESS WETLANDS

Background

Over the last 100-150 years, forested wetlands throughout the Southeast have been drained and converted to farmland, pine or hardwood plantations, and industrial and commercial developments. Of the estimated 45 million acres of floodplain forest once present in the Southeast, it is estimated that no more than 30 million acres remained by the mid-1980s (Hunter 1997). This trend in loss of forested wetlands has continued to the present time. Most of the remaining forested wetlands in the Southeast have been logged at least once and frequently fragmented. This fragmentation may contribute to the decline of many rare but wide-ranging species. Forested wetlands are considered a vital component of migratory bird habitat, both during the breeding season and as a stop-over habitat during migration.

Many forested wetlands in the Southeast are confined to narrow stream corridors in landscapes dominated by pine plantations and agricultural fields. These forested wetlands, referred to as hardwood-cypress wetlands on the CNF, can perform several important functions. When adequate in size and configuration, wetlands enhance biological diversity by providing habitat for forest species. Within forested wetlands, riparian areas also provide travel corridors for the dispersal of wildlife between forest fragments and may help to maintain genetic contact between potentially isolated populations in adjacent mature stands. If wide enough to have limited side lighting, a closed canopy, shaded understory, and detritus ground cover, riparian areas can support large populations of reptiles and amphibians.

The width of forested wetlands and associated riparian areas is important in ecological functioning. Wide riparian forests maintain higher abundance of amphibians, black bear, deer, turkey, reptiles, small mammals, waterfowl, and nongame birds than narrower corridors.

Several studies have indicated a positive correlation between hardwood wetland corridor width and density and diversity of interior neotropical migratory birds. Research conducted by Keller and others (1993) indicated that riparian forests less than 100 meters wide were dominated by species that are short-distance migrants; forest tracts wider than 100 meters had more neotropical migrant species, and numbers continued to increase, but much more gradually among forests wider than 200 meters. Dickson and others (1995) found that average bird abundance increased as streamside zone width increased. Wider corridors are more likely to provide habitat for these species and would likely provide more area away from forest edge.

Increase in edge and loss of habitat resulting from forest regeneration and fragmentation may reduce reproductive success of many neotropical migrants, particularly species that breed in mature forest interiors. Research studies have shown positive relationships between patch size and bird community complexity. However, certain man-made forest edges have been characterized as ecological traps for open-nesting passerine birds, because nest near these edges have high mortality from predation and cowbird parasitism.

Response to the Issue

Map the interconnected hardwood-cypress wetlands across the Croatan and manage them as a network of predominantly mature to over-mature hardwood cypress forested wetlands. Canopy coverage should be at least 80 percent; tree cavities, den trees and snags should be abundant; and large diameter logs should be distributed across the forest floor. Table 2.1 shows goals and objectives for maintaining hardwood-cypress wetlands.

2.1.7: RESTORE HARDWOODS ON SUITABLE SITES

Background

Oaks are the most important group of upland hardwood tree species in the South. They are widely distributed, have high timber value, and contribute to wildlife habitat. However, the acreage of oak-dominated forest types throughout the Southeast is gradually declining due to residential and commercial development, conversion to farmland, conversion to short-rotation pine plantations, and oak decline. This trend is projected to continue.

Oaks are a keystone species in eastern wildlife communities (Brown and Heske 1990). Some part or another of an oak plant is eaten by 186 different kinds of birds and mammals. Oaks are the primary source of hard mast in eastern forests. Acorns are an important food for many wildlife species, and the abundance of the annual acorn crop can influence the movement and abundance of several wildlife species, including popular game species, such as wild turkeys, black bears, squirrels, and white-tailed deer.

The abundance and distribution of oak mast significantly affects bear natality, mortality, and movements. Many research studies have documented significant movement to sources of hard mast, as well as to high carbohydrate agricultural foods on private land. This movement is evidenced by the high concentrations of female bears on private land, making them more vulnerable during fall bear hunting seasons. Studies show that during the pre-denning period, bears depend heavily on hard mast from trees.

Studies in Ohio show that the fall density of gray squirrels and fox squirrels is significantly correlated with the size of the hard mast crop from the previous year. Weigle and others (1989) found that the annual acorn crop in longleaf pine forests significantly influenced annual movements and reproduction of eastern fox squirrels in southeastern North Carolina.

Acorns are the most important food item for eastern wild turkeys. Korschgen (1967) reported that acorns comprised almost half of the food consumed by turkeys in Missouri. Acorns provide more than three times as much food as the next most important food item. Reports also show mast crops affect populations of white-footed mice and redheaded woodpeckers.

The value of acorns extends beyond the direct consumers, because several acorn consumers are themselves important prey species. Acorn eaters are also the primary agents of oak dispersal. Replacing oaks with tree species that do not produce hard mast will have a profound effect on the organization and diversity of the forest wildlife

community (Healy 1991).

Response to the Issue

Locate forests that are currently dominated by hard-mast producing species. Using the ECS and other data, locate other forests that could be restored to this condition. Manage the upland hardwood sites as a mature, hardwood-dominated forest. Table 2.1 shows goals and objectives for restoring hardwoods on suitable sites.

2.1.8: RESTORE HYDROLOGIC FUNCTION & SUSTAIN AQUATIC ECOSYSTEMS

Background

Much of the aquatic environment on the CNF is created by the extensive pocosin wetlands. Acidity, salinity, size, and form of the aquatic environment are the principal factors that determine the nature of aquatic biological communities on the CNF. The five major groups of habitats found are: (1) sounds and estuaries, (2) moderately brackish transitional streams, (3) freshwater streams, (4) large pocosin lakes, and (5) ponds.

Each of these aquatic environments is uniquely important. Sounds and estuaries are important for marine fish and shellfish, and provide significant commercial fishing opportunities. Saltwater transitional areas of freshwater streams (i.e. moderately brackish transitional streams) provide wildlife viewing opportunities and sport fishing, and are important spawning and rearing habitat for anadromous and catadromous species, such as striped bass, American shad, and American eels. Freshwater streams on the CNF support high-quality fisheries for largemouth bass, chain pickerel, bluegill sunfish, and bullhead catfish. These streams also provide opportunities to view natural systems in isolated, relatively undisturbed conditions.

Two of the larger pocosin lakes, Great Lake and Catfish Lake, have a total area of approximately 2,800 acres, and support a variety of aquatic species. Because of high acidity (pH often less than 4.0 units), uniformly shallow depth, and nondiverse form, the lakes have very limited potential as sport fisheries. The large borrow pit pond in the Black Swamp Creek drainage provides excellent sport fishing opportunities in a fully accessible environment. While pocosin lakes and the numerous small ponds on the CNF have limited value for recreational fishing, they may contain rare species and provide excellent microhabitats for a variety of plant and animal species. Due to their limited distribution and variability across the landscape, they can be considered rare natural community types.

Although some of the large coastal rivers around the CNF suffer from municipal and agricultural pollution, most aquatic environments on the forest are relatively undisturbed. The extensive drainage ditches across the forest, and those hydrologic changes attributable to the ditches, are the most visible human disturbance to aquatic environments.

Response to the Issue

Protect or restore aquatic ecosystems across the range of aquatic ecological types using the highest quality reference site conditions for each of the 11 ecological types (Appendix

H) on the Croatan National Forest. Restore hydrologic function of altered landscapes. Table 2.1 shows goals and objectives for restoring hydrologic function and sustaining aquatic systems.

2.2: Recreation Opportunities

2.2.1: INCREASE RECREATION OPPORTUNITIES

Background

The highest demand for recreation on the CNF is associated with water. The CNF offers a wide variety of water-based recreation opportunities. Developed recreation sites are generally located on significant bodies of water within a few miles of the Atlantic Ocean, and most are affected to some degree by tidal influences. The character of developed sites ranges from rustic to highly developed. Current capacity (people at one time) in highly developed sites is approximately 1,000, in moderately developed sites about 400, and in rustic developments about 175. In 1990, the CNF began a major renovation effort at the two largest recreation complexes, Cedar Point and Neuse River. The renovation increased the number of highly developed recreation sites. However, a lot of use still occurs in areas with few or no facilities. Places for groups to gather and camp close to the water are still in demand, along with camping areas that are more rustic in design.

Trail demands are increasing for horse, mountain bike, and off-highway vehicle use. These trails allow recreationists to experience many ecosystems. At present, horse and mountain bike riders use existing roads, but would prefer a series of interconnected trails with trailhead parking and access. OHVs, on the other hand, have access to many routes along with specifically designated trails. However, the combination of trails and roads do not currently make an interconnected system for OHV use. Additionally, many of the existing trails are in areas with sensitive vegetation. The designated system is difficult to mark and confusing, often resulting in users riding on undesignated trails. The need exists to designate and manage one area for a complete, safe and enjoyable OHV trail experience, which is separate from horse, bike and hiking trails, and which protects sensitive plant and animal habitats.

Interpretation of the natural and cultural resources is an ongoing process on the CNF. Explaining human history, unique ecosystems and special features enhances a visitor's experience. Existing levels of interpretation will be maintained at Cedar Point, Brice Creek, and Island Creek.

Response to the Issue

Provide a wide range of safe and enjoyable recreational facilities and opportunities that focus on water, with settings varying from rustic and natural to more developed. Accommodate the varied ability levels of forest visitors at developed sites. Develop new interpretive exhibits to explain longleaf pine savannas, pocosin, and old growth. Provide a system of marked recreational trails and support facilities to promote a variety of experiences for both motorized and non-motorized trail users. Minimize the impacts to natural resources from recreation activities. Support the maintenance of facilities and trails in part by user fees, and cooperative agreements for volunteer maintenance. Table

2.2 shows goals and objectives for increasing recreation opportunities.

2.2.2: EXPAND HUNTING, FISHING, & WILDLIFE-RELATED RECREATION OPPORTUNITIES

Background

As commercial and private development continues on private land surrounding the CNF, and more private land is leased for hunting and not available for general public use, national forest land will provide an increasing proportion of public hunting opportunities in North Carolina.

In response to decreases in small-game populations, and rapid increases in deer and turkey populations, hunting demands have shifted to white-tailed deer and wild turkeys. Black bear hunting receives local pressure as well as pressure from mountain bear hunters. Migratory bird hunting continues to be in high public demand, as evidenced by the number of hunters utilizing public waterfowl hunting areas in eastern North Carolina. Public interest and demand for wildlife viewing continues to rise.

Response to the Issue

Provide for a range of compatible and accessible wildlife-related recreation opportunities to accommodate current and projected public demands. Table 2.2 lists goals and objectives for hunting, fishing and wildlife related recreation opportunities.

2.3: Special Land Allocations

2.3.1: WILDERNESS

Background

In 1984 the North Carolina Wilderness Act established four wildernesses, totaling 31,221 acres on the CNF. These four areas are on high and low pocosin. They contain a high diversity of plant species that are fire dependent. These wildernesses are difficult to penetrate on foot, and as a result have a higher value as biological benchmarks than for recreation use and solitude. They provide contiguous, large areas of relatively undisturbed land that function as habitat for black bears, and other species. The wildernesses north of Catfish Lake Road are part of the State of NC black bear sanctuary. The wildernesses also provide large, intact examples of the pocosin ecosystem, and many are also designated special interest areas in cooperation with the NC Natural Heritage Program.

The single most destructive disturbance to the natural processes has been in the form of fire suppression. Due to years of fire suppression resulting in fuel accumulation, the majority of the land within wildernesses is losing the ability to function as diverse, fire-dependent ecosystems. The increased development along the perimeter of the designated Wildernesses increases the risk of fire escaping from private land into the wilderness. The accumulation of heavy fuel loads creates a public safety hazard adjacent to populated areas, as well as an increasing severity of consequences for wilderness resources. Along with the destruction that is apparent in uncontrolled or escaped fire, a less apparent concern is the amount and duration of smoke produced during these types of fires. To

reduce fuel loads, maintain manageable fuel conditions, and in the process sustain the fire-dependent ecosystems within the wildernesses, fire must be reintroduced as a management tool.

An additional 20,771 acres in six areas qualify for evaluation for potential wilderness designation. These areas are also in pocosin and are adjacent to the existing wildernesses. Some additions involve land acquired since 1984, and some, if designated, would make boundary identification on the ground much easier. Appendix C of the EIS contains the wilderness evaluation for these areas. If the roadless areas were designated, wilderness would make up almost one-third of the CNF.

Response to the Issue

Protect and enhance the unique attributes and characteristics of Sheep Ridge, Pond Pine, Pocosin, and Catfish Lake South Wildernesses. Retain the values of the large, intact areas of relatively undisturbed pocosin, which add to the richness and diversity of the region and the CNF. Enhance opportunities for ecological systems to function as freely as possible. Modify over time those conditions that are presently constraining natural systems, such as invasive species and unnatural fuel loading, to enhance the natural integrity of each wilderness.

Use the Minimum Requirement Decision Guide (Arthur Carhart National Wilderness Training Center 2002) to identify a variety of methods that may be used to reduce decades of fuel accumulation resulting from fire suppression. Mechanical treatments may be one method used to reduce fuel accumulations. Once fuel loads are at a level that reduces the risk of uncontrollable wildfire escaping the designated Wilderness, use both management ignited and natural ignition fire to maintain the level of hazardous fuels. When conditions are returned to those allowing for it, allow lightning-caused fire (i.e. natural ignition) to function as much as possible as a natural process.

Use fire lines within Wilderness only during wildfire suppression when shown to be necessary for safety. Fire lines may also be used within Wilderness where necessary to accomplish fuel reduction for human health and safety in those areas adjacent to the wildland-urban interface. Within the Wildernesses, cultural and ecological constraints on fire operations include adjacent private land and smoke management. Additional constraints may be identified when Fire Management Plans are developed for the Wildernesses.

Enhance opportunities for visitors to experience primitive recreation and solitude in portions of the wildernesses where it is practical and wilderness values can be sustained with a minimum of restriction. Emphasize leave-no-trace principles for wilderness visitors. Encourage visitors not desiring a wilderness experience to use less primitive areas of the Forest. Establish, where feasible, horseback riding trails, as well as hiking trails through portions of the wildernesses. Locate some primitive campsites along lakeshores and along trails into the pocosins. Roadless areas not designated, as wilderness will be managed as natural, remote, and difficult to access. Enhance opportunities to interpret the ecological and scientific values of the wildernesses. Provide

off-site interpretive material that explains the unique attributes of pocosin ecosystems and these wildernesses.

Table 2.3 lists goals and objectives for wildernesses; table 2.5 lists goals and objectives for fire.

2.3.2: RIVER CORRIDORS ELIGIBLE FOR WILD AND SCENIC RIVER STATUS

Background

In 1968, the Federal Wild and Scenic Rivers Act was passed to protect designated rivers from federally licensed water resource projects that would affect the free-flowing condition of the river, or directly and adversely effect the values for which the river was designated. Thus, any designated river segment is managed to “protect and enhance” those values that contributed to designation in the first place.

Less than one percent of all the river miles in the Nation have been included in the Wild and Scenic Rivers System. In contrast, over 17 percent of all river miles have been dammed. In the National Forests in North Carolina, 11.4 miles have been designated; none of these are on the CNF. Two rivers on the CNF, the White Oak (39.5 mi.) and Brice Creek (27.4 mi.) have outstandingly remarkable values and are in a relatively natural condition. They are eligible to be evaluated for designation to the Wild and Scenic River System. Both contain outstandingly remarkable values for scenery, fish and wildlife habitat, and historical and archeological sites.

The river corridors contain predominantly black water coastal rivers that drain swampy and marshy areas of the interior pocosins. The ecosystems include broad and sluggish saltwater marsh lined with cord grass, stands of large hardwoods and pines, and hardwood swamps that are narrow and meandering. Water quality meets State and Federal quality standards.

Response to the Issue

Retain, through specific management, the outstandingly remarkable values for scenery, fish and wildlife habitat, historical and archeological resources, natural settings, and free flowing condition, that make the White Oak River and Brice Creek suitable for wild and scenic river status. Protect Class I and II archeological sites and provide interpretation for visitors. Table 2.3 lists goals and objectives for river corridors eligible for wild and scenic river status.

2.4: Silviculture, Forest Products, And Forest Health

2.4.1: RESTORE LONGLEAF PINE

Background

In the past, silvicultural activities in coastal plain forests included intensive preparation of all sites for planting of genetically improved longleaf pine and loblolly pine seedlings. Survival and early growth were good, and short timber rotations were envisioned. The question of which species was best suited for a particular site was decided based on performance of that species on similar sites. Regeneration efforts for both species have

been successful with respect to short-term survival rates, growth, and development of seedlings.

When management objectives include longer rotations, rapid early growth may not be necessary, and site preparation methods that cause less disturbance may be more appropriate. Less intensive site preparation methods in conjunction with natural regeneration and longer rotations can meet management objectives.

Southern pine beetles have not been a large factor in the management of the CNF. Beetle activity has been moderate. Cutting and removing infested trees have controlled most spots. In 1998 and 1999, Southern Pine Beetle activity increased in the western and northern portions of the CNF, primarily in pond pine woodland, mixed pine, and pocosin ecological types. Over 500 acres of pond pine and mixed pine types were infested. Control efforts were limited to cut leave strips to contain spread within the pocosin.

In 1996 and 1997, hurricanes damaged significant portions of the Croatan. Most heavily damaged were hardwood sites, where individual stems were uprooted, creating a mosaic of canopy gaps. Damage to pine stands ranged from individual trees being broken at midstem and uprooted to small patches where every tree was damaged. Loblolly pine appeared to be more heavily impacted than other pine species. Salvage operations spanned several years, and had a large impact on District personnel resources.

Approximately 26,000 acres on the CNF are considered suitable for sustained timber production (Appendix I).

Response to the Issue

Use an ecosystem approach to manage forests for wildlife, timber, and recreational benefits, and threatened and endangered species. Emphasize forest management practices that imitate natural disturbance to maintain structure, native species composition, and important ecosystem functions such as nutrient and energy cycling, seed production, and wildlife habitat. Use a variety of methods to regenerate species best adapted to local growing conditions and natural disturbance regimes on the CNF while maintaining native overstory and understory species diversity. Maintain the vigor and health of forests by using stand improvement methods such as prescribed burning and thinning, and by reducing the spread of insect and disease through cut-and-leave operations or timber salvage. Table 2.4 lists the goals and objectives for restoring longleaf pines.

2.4.2: SUSTAIN PINE STRAW PRODUCTION

Background

Pine trees deposit a blanket of needles on the forest floor every year. Pine needles, commonly called pine straw, are used throughout the South as mulch for landscaping. Demand for pine straw is increasing, and many land managers in the South have included pine straw production as a management objective because it is profitable. Longleaf pine is the most desired species for pine needle production due primarily to the length of the needles.

Management for pine needle production includes maintaining a sparse understory to facilitate the raking or collecting of the needles and periodic fertilization to maintain site productivity for tree growth as well as needle production. However, repeated raking of pine needles may potentially damage native understory plants, including rare species, and may reduce their viability on the CNF. Intensive and/or extensive use of pine straw raking without mitigation and specific site selection may therefore not be compatible with maintaining plant species diversity on the CNF.

Response to the Issue

Allow pine straw raking on a limited number of sites and well away from rare species populations. Sustain pine straw production and maintain site productivity on these sites through rest and rotation, and periodic fertilization. Table 2.4 lists the goals and objectives for sustaining pine straw production.

2.5: Fire Management

Fire is one of the primary natural disturbances to the fire-dependent ecosystems of the CNF, and plays a vital role in the management of these ecosystems. Periodic fire helps to limit hazardous levels of fuels, as well as prepare seedbeds for longleaf pine seed. Using fire as a tool to meet land management objectives is necessary in the Coastal Plain. Research results commonly support the theory that fire was used historically to modify vegetation, and its use continued long enough to have an effect on species composition and arrangement.

The terms *fire adapted* and *fire dependent* refer to those species that have evolved in conjunction with fire. Fire adapted plants have developed characteristics which may allow them to survive when others would not, such as higher moisture content, thicker bark or spreading at ground level to preclude a fire reaching the bole of the plant. These plants would most likely survive a lack of fire as well; although the other environmental changes caused by the lack of fire, such as increased competition, may negatively affect them. Fire dependent species require the influences of fire to survive. In some plants it may be that the high temperature and dry heat of fire is needed to open seedpods or to provide the necessary seed beds to establish. These plants will be eliminated from the ecosystem over time in the absence of fire.

Fire hazard is a term used to refer to the combination of both risk and consequence of a fire occurrence. Risk refers to the level of opportunity or chance of an ignition, while consequence is the term applied to the results of an ignition. An area may have a high risk (probability for an occurrence) while having a low consequence (little resource value lost), or in the other direction a fire may have a lower risk (small probability for occurrence) and extreme consequences (such as the loss of a home). Fire, when used as a tool, effectively and efficiently helps to limit hazards associated with the accumulation of fuels, which directly affects the severity of consequences of ignition.

2.5.1: REDUCE WILDFIRE-RELATED RISKS

Background

Due to ownership patterns in and around the CNF, the primary wildfire hazards occur in the wildland-urban interface. The wildland-urban interface is defined as that line, area or zone where structures and other human developments meet or intermingle with undeveloped wildland or vegetative fuels (Review and Update of the 1995 Federal Wildland Fire Management Policy, Jan 2001). This zone defines a type of fuels/fire environment not the resource values or ownership of the individual components of the environment.

Protection of human health and safety is the primary, overriding management guideline for fire management programs. Secondary factors guiding fire management programs include resource values, and reducing the level of risk and consequence to those resources. Resources at risk include homes and improvements as well as large blocks of high value industrial tree plantations and rare ecological communities. Risk to resources exists both from fire spreading onto federal land from private land, as well as from federal land to private land.

Areas are at varying degrees of risk based on prior burning history, resources present, and ability to be defended from wildfire. On the CNF, approximately 5355 acres pose high potential risk for 3 main reasons: position on the landscape, heavy loads of highly volatile fuels, and organic soils.

Examples of devastating, uncontrollable fires occurring on the Croatan National Forest include Pocosin Fire of 1955, which burned almost 73,000 acres including the Sheep Ridge and Pocosin Wildernesses. The Fish Day Fire (May 21, 1994) consumed 24,600 acres. While the wildfire remained on national forest land, suppression costs exceeded \$1.7 million. Fortunately, no fatalities, injuries, or structure losses were associated with this fire. As the level of use of the land in and around the forest increases, it may be expected that the occurrence of human caused fires will increase also. As the level of private development in and around federally managed lands continues to increase the consequences of an escaped fire increases also.

Response to the Issue

Reduce the levels of hazardous fuels, utilizing a variety of methods, to reduce threats to public health and safety as well as to help lessen the chance for resource damage from wildfires. Manipulate the arrangement and availability of the current fuels to allow for the safe reintroduction of fire. Work with local cooperators and involve the public in fire education, and identifying opportunities for using fire positively. Through the use of available programs, such as *Firewise*, encourage and support local communities in attempts at creating defensible space within privately owned areas. Within agency guidelines involve local communities in developing economic benefits attached to hazardous fuels reduction projects.

Continue the use of prescribed fire in areas that have been previously burned. Participate in and use research to allow expanded use of fire into areas where it has historically been limited due to highly volatile fuels and organic soils, which leads to smoke management and fire control problems.

Considering cumulative effects, expand the perimeter of those areas in which fuel loads have been reduced and over time connect treated areas together to create defensible buffers. Once fuel loads are adequately reduced provide opportunities to use minimum-impact suppression techniques during wildfires. Table 2.5 lists goals and objectives for reducing wildfire related risks.

2.5.2: EXPAND THE ROLE OF PRESCRIBED FIRE

Background

Approximately 70 percent of the CNF is occupied by short interval fire-adapted ecosystems such as pine forest and pocosins. Fire is a primary instrument for nutrient cycling in coastal ecosystems, making them dependent on such disturbance. The absence of periodic, low-intensity fire in these ecosystems causes relatively rapid changes in the species composition and structure of communities. In turn, fire exclusion can predispose these communities to insect and disease outbreaks and severe stand replacement wildfires (Williams 1994). The 1955 Pocosin Fire and 1994 Fish Day Fire are examples of stand replacement type wildfire.

By changing the fuel arrangement and availability conditions can be produced that will allow fire to be applied at short intervals during times of the year when natural fires historically occurred. Reintroduction of fire -- into areas where, in more recent history it has been excluded -- may result in an increase in species diversity, sustainability of resources, and more complete nutrient cycling. While natural fire regimes may not be wholly recreated, a reduction of fuel loads combined with the use of fire may assist in creating the desirable conditions of short-interval systems that were once a product of natural fire regimes.

Using fire as a tool is vital to accomplishing restoration of a variety of natural vegetation communities. Restoring longleaf pine with the least amount of impact requires frequent and consistent application of fire to control competing pine species and other woody competitors. Due to the amount and sensitivity of surrounding developments, the amount of smoke produced and its duration in the area are a primary concern. The use of fire in pocosins has long been the subject of research. Scientists continue to explore these fire-adapted and fire-dependent communities. Research is ongoing to determine groundwater levels that will minimize organic soil consumption or possibly prohibit organic soil ignition entirely, which in turn minimizes smoke produced.

The management of *naturally* ignited wildland fires to accomplish specific, pre-stated resource management objectives in predefined geographic areas is referred to as wildland fire use. The Forest Land Management Plan establishes where it is acceptable to allow natural ignition to be used while the Fire Management Plan provides the tactical

information used as safety parameters for allowing natural ignitions to burn unsuppressed.

With fuel load reductions, implementation of a Fire Use Program may be possible, which allows natural ignition to be used as a management tool. Risks and trade-offs are associated with a Fire Use Program. Decisions are based on resource objectives and preset fire behavior and control parameters. In contrast with natural ignition, resource managers can control the timing, point, rate, and pattern of ignition for management-ignited fire. Management-ignited firing techniques may provide more complete combustion of fuels and achieve similar resource objectives with less smoke emission than smoldering fires that result from natural ignitions. The ability to predict atmospheric conditions that enhance smoke dispersion, and the use of that knowledge when timing ignitions, also helps lessen the impact of smoke on the surrounding areas. While natural and man-made barriers are identified in a Fire Use plan, the lack of emphasis towards immediate suppression may imply some risk of fire escape. The political and social ramifications of this possibility may be deemed unacceptable.

Response to the Issue

Use fire to prepare seedbeds for longleaf pine restoration, control competing pine species, and to improve existing longleaf pine stands. Use prescribed-burning techniques to create a mosaic pattern for improving browse, opening the understory, and maintaining mast production for black bears, turkeys, and white-tailed deer. Expand the role of fire to recover and sustain short interval fire-adapted systems. Participate in research and cooperative opportunities to increase the understanding of burning in organic soils and smoke management constraints. Initiate the cooperation of local resources in developing and implementing fire use education and/or economical opportunities.

Develop a Fire Use Program for the CNF. Include lands in all management prescriptions where the use of fire may achieve the desired conditions and goals outlined in the Forest Plan. Site-specific Fire Use Plans will be developed as part of the Croatan Forest Fire Management Plan to outline the prescription parameters.

Table 2.5 lists goals and objectives for expanding the role of fire.

2.5.3: *MAINTAIN AIR QUALITY*

Background

The Croatan currently uses prescribed fire 12-25 days a year. To date, there have been no violations of any National Ambient Air Quality Standard in the CNF. An increase in prescribed fire will increase the amount of particulates, volatile organic compounds, nitrogen oxides, and carbon monoxide emitted into the atmosphere. Emissions of particulate matter from prescribed fires are of concern because: (1) excessive amounts are known to result in an increase risk of respiratory diseases, and (2) large amounts in the atmosphere can reduce visibility along highways and increase the likelihood of vehicle accidents.

Large amounts of fine (less than 2.5 microns in size) particles in the atmosphere are known to reduce visibility. They affect not only the distance a person can see, but also the apparent color and texture of objects. Studies of fine particle chemistry in the Eastern United States reveal that sulfates make up 60 to 80 percent of fine particle mass. Scientific studies have also demonstrated that visibility degradation from regional haze is highest during the summer, when sulfate concentrations are greatest. On a regional basis, particles from prescribed fires comprise a small portion of the regional haze.

Nevertheless, a majority of the particulates released from prescribed fires are extremely small, and these particles have the potential to reduce air quality locally. Smoke that is released into an atmosphere with poor dispersion capabilities can cause significant safety problems on highways. Visibility reductions can be exacerbated if relative humidity is high. Furthermore, severe reductions in visibility can occur at night because the smoke follows stream drainages, and highway visibility can be especially poor at bridges where fog and smoke may be present.

Particles from forest fires vary widely in their size, but the current standard focuses on particles 10 microns in diameter. The 24-hour particulate matter standard is violated when the second highest measured value is greater than or equal to 150 micrograms per cubic meter. An equivalent value for the standard for total suspended particulate matter (particles 40 microns or less in size) is 300 micrograms per cubic meter (Wergowski 1995). Examination of the maximum 24-hour total suspended particulate matter data between the years 1985 and 1994 within 200 kilometers of the CNF reveals that the maximums range between 96 and 199 micrograms per cubic meter. These values are well below the current standard.

Response to the Issue

Maintain compliance with National Ambient Air Quality Standards. As prescribed fire levels increase over the next 10 years, the amount of particulates in the atmosphere will increase. However, with the reduction in fuel loading that will occur with increased burning, the amount of particulates in the atmosphere will taper off. More smoke will be seen and smelled in the atmosphere with increased prescribed burning levels. Continue using stringent mitigation measures for visibility when smoke may cause problems on roads and highways. Table 2.5 lists goals and objectives for maintaining air quality.

2.6: Access

2.6.1: PROVIDE ACCESS WHILE PROTECTING NATURAL RESOURCES

Background

About 350 miles of North Carolina State roads provide primary access to the CNF. Two hundred miles of Forest Service roads also provide access for motorized vehicles, and over 20 road miles on the CNF occur near urban areas. About 178 miles (89 percent) of the CNF road system are open to the public continuously, and 9 miles (4 percent) are seasonally open. Balancing reasonable public access with protecting the natural resources is a critical challenge for national forest management. Too much access causes problems

with trash dumping, unregulated shooting, unauthorized use of closed roads, resource damage, and the creation of new trails and roads. High levels of access also increase negative impacts to wildlife, and increase the cost to maintain roads to an adequate standard. An association seems to exist between dead-end roads and illegal activities. However, limiting access too much restricts the public from through roads and from using the national forest in ways that they enjoy such as biking, hunting, bird watching, OHV riding, and camping.

Over 120,000 pounds of trash have been deposited across 30 miles of road. Unregulated target practice takes place in areas of the forest, sometimes close to homes, creating significant safety risks. Disturbance from motor vehicles can reduce the reproducing capacity of black bears and wild turkeys.

The network of unauthorized and illegal roads that exist on the CNF, including approximately 75 miles of OHV trails, is causing impacts to the natural resources. Many of these routes (22 miles) are in the clearings beneath powerlines or in the sandy soils (27 miles) along the southern border of the forest. These areas have high densities of threatened and endangered species. In wet weather, the surfaces of these routes often become too deeply rutted to use, and a new route paralleling the first is created. Illegal access to closed system roads is destroying thin gravel surfaces and, in many cases, is making access for fire suppression and other management activities impossible.

Additionally, access to closed system roads is gained by driving around existing gates. Non-system roads, trails, and powerline rights-of-way are accessed from system, state, and private roads. The estimated cost to close all of these routes effectively is over \$150,000.

Maintenance is more expensive for roads that are open all the time than for roads that are closed except to administrative use. The average open-road maintenance cost is \$500 per mile, compared with \$100 per mile for closed roads. Many open roads are currently in disrepair: large holes and ruts are created during passage in wet weather. Future maintenance funding is expected to remain stable or decline, and many open roads, including some critical for fire protection, will soon become impassable.

Response to the Issue

Close unauthorized routes and some classified roads to reduce safety risks resulting from unregulated shooting and dumping and to protect natural resources. Reduce opportunities for illegal trash disposal by focusing road closures on dead-end roads. Reduce the impacts of unauthorized and illegal access by closing most of these routes with effective methods, such as gates or ditching. Enhance black bear and wild turkey habitat by reducing motorized access to core areas.

Access to most recreation places and some hunting grounds will be maintained. However, motor-vehicle access will not be provided to every place on the forest. Maintenance funds will be concentrated on fewer open roads, so those roads will be improved. Focus

maintenance funds on roads in disrepair with high-use traffic patterns. Table 2.6 lists goals and objectives for providing access while protecting natural resources.

2.7: Local Communities

2.7.1: ADJUST LAND OWNERSHIP

Background

Currently, the proportion of county land in the CNF is 16.5 percent in Carteret County, 14 percent in Craven County, and 13.4 percent in Jones County. Forestwide, national forest ownership consists of 14.6 percent of all three counties (159,586 acres of the 1,089,280). The Forest Service purchases and trades land to enhance management of natural resources, and consolidate national forest tracts. For example, acquiring land in areas such as the White Oak River Corridor would further overall resource management goals while protecting sensitive ecosystems. The availability of large undeveloped tracts of land under private ownership in these areas provides opportunities to acquire land that has not been influenced by development.

A land ownership adjustment plan (Appendix D) projects where land adjustments are likely to occur, and identifies objectives that land adjustments would fulfill. During this planning process, priorities were established for land adjustment. These priorities identify areas of the forest that would be high priority for acquisition. A landownership adjustment map has been developed and incorporated into Appendix D. All new proposals must result in net public benefits, and be consistent with the plan and the landownership adjustment map.

In the land adjustment plan, 43,917 acres have been identified as desirable for acquisition based on resource, recreation, and consolidation management needs along with 1,783 acres identified for disposal through land exchanges. Under ideal conditions (available funding, willing partners, etc.) total national forest ownership would account for approximately 20.2 percent in the tri-county area (219,570 acres).

Response to the Issue

Acquire land or interests in land needed to support natural resource management and recreation objectives. Consolidate national forest holdings to improve efficiency and enhance public benefits. Exchange or transfer land to consolidate or provide public benefits. Acquire rights-of-way or fee simple titles to meet access needs. Use purchase, donation, exchange, right-of-way acquisition, transfer, interchange, and boundary adjustment to consolidate ownership pattern, to mitigate for wetland drainage, and to provide linkages to other biologically significant areas, such as Marine Corps Air Station Cherry Point, Hoffman Forest, and Marine Corps Base Camp Lejeune. Support other organizations that acquire conservation easements when the easement is on property that would enhance National Forest management. Table 2.7 lists goals and objectives for adjusting land ownership.

2.7.2: REGULATE SPECIAL USES

Background

Since 1951, the demands placed on CNF land have increased because of the development of private land and wetlands in Craven, Jones, and Carteret Counties. Near urban areas, especially the towns of Havelock and Newport, CNF land is being used to support local infrastructure because the amount of open private land in the area is limited. Public services relate to over 50 percent of the special use permits on the CNF. That percentage is highest among national forests in North Carolina.

The number of new special-use permits issued in the last 10 years is 36 percent of all permits issued since 1951. That percentage also is unusually high. Currently, special uses occupy approximately 1,362 acres or 1 percent of CNF land. An additional 4,000 acres are adjacent to public water systems and landfills protected so that water quality standards can be met. The majority of special uses (approximately 75 percent) occur in the eastern and southern parts of the forest adjacent to the towns of Havelock and Newport and their surrounding communities.

New requests for permits that serve a public benefit range from the construction of major interstate highways, such as the U.S. 70 Bypass (1,100 acres) to the construction of a disaster coordination center for the tri-county area (30 acres). Private uses, which account for 50 percent of special uses, also vary but only occupy about 20 percent of the total acres under permit. Support from local communities is critical for management of special use acreages consistent with forest goals and objectives.

Response to the Issue

Manage special uses of CNF land in a manner that protects natural resource values and public health and safety, while meeting land and resource management objectives. Administer special uses that are compatible with natural resource management objectives and sound business management principles. Table 2.7 lists goals and objectives for special uses.

2.7.3: CONTRIBUTE TO SUSTAINING LOCAL COMMUNITIES

Background

The communities that surround the Croatan National Forest are an integral part of the character of the land. The people that make up these communities influence the care and management of the Croatan National Forest through their heritage, duration in the area, ethnic background, vocation, socioeconomic status, and views of the natural world. People's ways of relating to their environment create bonds of attachment to places and features. People's perceptions of a place or the physical area where they interact give that area special meaning to them, their community, or their culture. Natural resource managers refer to this shared, or communal perception of place as "sense of place" (Southern Appalachian Assessment Social/Cultural/Economic Report 1996).

Managing the Croatan National Forest in a sustainable way while still providing for the public's needs for recreation, solitude, forest products, access, hunting, and other activities, requires a collective effort between forest managers and local communities. A strong sense of place in the local communities will contribute to this effort. However, the population dynamics of this area creates a unique challenge in developing a sense of place.

The local communities in the three counties surrounding the Croatan National Forest are constantly changing, and have been since the forest was established on July 29, 1936. The long-term residents are primarily descendants of the original European settlers (mostly Swiss and German) who came to the region in the 18th century. They farmed the land and utilized the natural resources of the region, primarily its fisheries and forests. However, the population is changing due to an infusion of new residents, seasonal residents and retirees. A large contributor to the local community, both economically and population-wise, is MCAS Cherry Point. The Air Station has been a long-standing part of Craven County since 1942, but its population of Marines, sailors and families is constantly fluctuating. This presents a unique challenge to developing a sense of place with transient segments of the population.

With changes in population, attitudes about the uses of the national forest also change. Long-term residents tend to view the CNF as "common" land where they can hunt, fish, and recreate without many restrictions. Timber harvesting and other traditional land uses are accepted practices, but attempts to establish and enforce regulations are generally resisted. Newcomers view the national forest as a place for recreation and consider rules and regulations as necessary to ensure a quality experience. Timber harvesting, road construction, or other activities that can alter the landscape, even temporarily, are generally not accepted. The transient segment of the population generally holds fewer strong beliefs about activities on the forest, and sees the effects of management in a much shorter timeframe.

Response to the Issue

Work with local communities to identify complementary goals for land management. Identify uses and values to provide in and around the CNF in collaboration with local communities, governments, and user groups. Sponsor special events in conjunction with local communities to help develop sense of place with population segments. Develop action plans with local communities and governments to sustain the places and features that make the area unique. Inform local governments about the value of the CNF as open, greenspace, and how that contributes to quality of life. Actively seek input from local governments on implementation of the CNF Plan's goals and objectives.

Provide information about natural environments to foster nature-based tourism and related small businesses. Enhance the quality of life for local citizens by providing opportunities to understand coastal environments and the challenges to sustain them. Contributing to a community's sense of place is an understanding of the history of the area. Managing, protecting, preserving and interpreting heritage resources will be an important component of developing sense of place. In addition, encourage and conduct

scientific research at available heritage sites, potentially using the Passport in Time program, which can involve interested publics.

Work with local cooperators and the public in developing and implementing fire education programs and identifying opportunities for using fire positively. Through the use of available programs, such as Firewise, encourage and support local communities in the creation of defensible space.

Forestwide Goals/Desired Conditions and Objectives per Issue

2.1 Biological Diversity:

Issue	Goal/Desired Condition	Objectives
Issue #1: Recover RCW Populations: <i>While recognizing the complexity of biological diversity, and the vast levels or scales at which to consider species and ecosystems, what should the Plan focus on to contribute to the recovery of the endangered red-cockaded woodpecker, and restoration of its native habitat?</i>	2.1.1. Recover a viable population of RCW through joint efforts with Marine Corps Base Camp Lejeune and Holly Shelter Gamelands.	2.1.1.1. Meet a long-term population objective of 137-169 RCW clusters.
		2.1.1.2. Maintain the existing 63 active RCW clusters.
		2.1.1.3. Establish 20 to 26 new RCW clusters over the next 10 years (2002 - 2012).
		2.1.1.4. Establish 50 to 63 new clusters during the next 30 years (2002-2032).
		2.1.1.5. Reach Management Intensity Level 2 (MIL 2) in the early years of plan implementation.
		2.1.1.6. Maintain the existing 12,000 acres of longleaf pine forest type as pine savanna.
		2.1.1.7. Monitor populations of RCW and the condition of the understory shrub, herb and grass layer (specifically wiregrass) to evaluate the effects of management actions on pine savanna habitat. Use the information collected to guide future management actions.

Issue	Goal/Desired Condition	Objectives
Issue #2: Identify and Protect Special Interest Areas <i>While recognizing the complexity of biological diversity, and the vast levels or scales at which to consider species and ecosystems, what should the Plan focus on to address the identification and protection of SIAs, and to what extent is official designation necessary as a means of managing multiple levels of biological diversity?</i>	2.1.2. Provide core areas for rare species and unique communities that represent the range of ecological conditions found on the Croatan.	2.1.2.1. Protect rare species in Special Interest Areas where population densities are high. Maintain habitat quality in these core SIAs.
		2.1.2.2. Allow natural disturbances such as lightning-caused fires and windthrow from hurricanes to function, as much as possible, as natural processes within Special Interest Areas.
		2.1.2.3. Evaluate the effects of natural disturbances on native plant communities and rare species in Special Interest Areas.

2.1 Biological Diversity (continued):

Issue	Goal/Desired Condition	Objectives
Issue #3: Recover and Sustain Rare Species and Communities. <i>While recognizing the complexity of biological diversity, and the vast levels or scales at which to consider species and ecosystems, what should the Plan focus on to expand consideration of biological diversity to the other rare species and communities that occur on the Croatan?</i>	2.1.3.a. Maintain viable populations of endangered, threatened, sensitive, and locally rare species on the CNF. 2.1.3.b. Provide conditions for species that are now locally rare or extirpated, but may return to the CNF if suitable habitat exists.	2.1.3.1. Use the network of Special Interest Areas, old growth, pine savanna and flatwoods-RCW habitat management area, and hardwood/cypress wetlands as core areas to maintain and increase populations of endangered, threatened, and sensitive species.
		2.1.3.2. Provide conditions for groups of species sharing similar habitat requirements using the ecological classification system to select suitable areas.
		2.1.3.3. Verify the current status of species with documented occurrence records more than 15 years old and now presumed to be extirpated. Use management practices that provide suitable habitat for these species. During the next 10 years, establish: <ul style="list-style-type: none"> • Two new subpopulations of spring flowering goldenrod; • One new subpopulation of mimic glass lizard; • One new subpopulation of Carolina goldenrod; • Five new subpopulations of rough-leaved loosestrife;
		2.1.3.4. Restore the following rare communities: 500 acres of canebrake, 7 acres of marsh, 10 acres of maritime forest, and 25 acres of Atlantic White Cedar.
		2.1.3.5. Maintain the following rare communities: the existing 25 acres of maritime forest and 20 acres of powerline corridors in a coastal prairie condition.
Issue	Goal/Desired Condition	Objectives
Issue #4: Restore Old Growth Forest. <i>While recognizing the complexity of biological diversity, and the vast levels or scales at which to consider species and ecosystems, how should the Plan focus on old growth, and the way it functions to support biological diversity?</i>	2.1.4. Provide old-growth forest conditions for the most common forest community types within a network of old-growth stands.	2.1.4.1. Conserve and restore upland mesic hardwoods, cypress-tupelo swamp forests, southern wet pine forests, woodlands and savannas, and upland longleaf pine through management prescriptions that allow for developing older stand conditions.
		2.1.4.2. Identify forests with old-growth conditions that are in a matrix of primarily mid- and late-successional stands. Maintain a network of old growth across all management areas and forest types to reduce the probability of widespread hurricanes eliminating all old-growth stands in one event.

2.1 Biological Diversity (continued):

Issue	Goal/Desired Condition	Objectives
Issue #5: Maintain Bear Habitat. <i>While recognizing the complexity of biological diversity, and the vast levels or scales at which to consider species and ecosystems, what should the Plan focus on to ensure maintenance of black bear habitat? Bears require large tracts of land, linkages between patches of suitable habitat, hard mast foods, and freedom from motorized disturbances.</i>	<p>2.1.5.a. Provide suitable habitat conditions for long-term viability of the black bear population on the CNF.</p> <p>2.1.5.b. Provide landscape linkages to other bear habitat and potential foraging areas on public and private land through the spatial arrangement of management areas with low motorized use, and a system of hardwood cypress wetland corridors. Minimize human disturbance and modification of black bear habitat, except where it is necessary to manage the habitat using tools such as prescribed burning.</p>	2.1.5.1. Maintain, using fire or other appropriate techniques, 53,000 acres of high pocosin habitat group (raised peatlands landtype) with approximately 15 percent in seedling and shrub successional stage (less than 6 years) and more than 50 percent as mature successional stage (>40 years).
		2.1.5.2. Maintain 15,000 acres of low pocosin habitat group (raised peatlands landtype) with 15 percent in seedling shrub successional stage (<10 years).
		2.1.5.3. Reduce disturbance from motor vehicles in the bear habitat management prescription. One effective method is to reduce the miles of open road.
		2.1.5.4. Provide 20 acres of soft mast for black bear. One method is to establish a minimum 5-10 miles of roadside soft mast buffers on roads closed to public motorized vehicles within the bear habitat management.
		2.1.5.5. Assist NCWRC with bear monitoring.

Issue	Goal/Desired Condition	Objectives
Issue #6: Maintain Hardwood Cypress Wetlands. <i>While recognizing the complexity of biological diversity, and the vast levels or scales at which to consider species and ecosystems, what should the Plan focus on to support neotropical migratory birds as well as the variety of other wetland-associated species?</i>	<p>2.1.6. Maintain a connective system of landscape corridors, consisting of hardwood cypress wetland and hardwood slope forest types, of adequate size and width. This system will provide five major benefits:</p> <ul style="list-style-type: none"> • Core habitat for interior neotropical migratory birds; • Travel corridors for black bear, turkey, and other terrestrial wildlife species; • Old growth riparian forest; • Filter strips for adjacent water run-off to maintain high water quality; and • Quality wood duck and waterfowl nesting and foraging habitat. 	2.1.6.1. Maintain or restore 6,200 acres of oak-gum-cypress habitat group (Lake and Stream Swamp Landtype) in mature successional stage with few canopy gaps.
		2.1.6.2. Continue to monitor permanent bird points that meet the Regional Landbird Conservation Strategy.

2.1 Biological Diversity (continued):

Issue	Goal/Desired Condition	Objectives
Issue #7: Restore Hardwoods on Suitable Sites. <i>While recognizing the complexity of biological diversity, and the vast levels or scales at which to consider species and ecosystems, what should the Plan focus on to restore hardwoods in areas that naturally supported this type of ecosystem?</i>	2.1.7. Maintain naturally occurring hardwood forests that are dominated by hard mast producing tree/shrub species. Restore these forests where the ecological classification predicts upland hardwood landtypes.	2.1.7.1. Maintain 1,700 acres of existing oak-beech-hickory habitat group (Stream and River Terrace Landtype) in mature (>60 years) successional stage.
		2.1.7.2. Restore about 2,000 acres of existing loblolly pine to hardwood and manage as potential hard mast producing hardwoods in the next 10 years.
		2.1.7.3. Monitor turkey populations to indicate the effects of managing oak-beech- hickory habitat groups.
Issue	Goal/Desired Condition	Objectives
Issue #8: Restore Hydrologic Function and Sustain Aquatic Ecosystems <i>While recognizing the complexity of biological diversity, and the vast levels or scales at which to consider species and ecosystems, to what extent should the Plan focus on the extensive amount of water and wetlands present on the Croatan National Forest, and the vast degree of biological diversity supported by properly functioning hydrologic and aquatic systems?</i>	2.1.8. Protect or restore aquatic ecosystems across the range of aquatic ecological types using the highest quality reference site conditions for each of the 11 ecological types on the Croatan National Forest. Restore hydrologic function of altered landscapes. Favor native plants and animals in aquatic systems.	2.1.8.1. Establish reference site conditions for the aquatic classification. Characterize aquatic ecological type reference site conditions by assembling the following information for three sample sites in each of the 11 aquatic ecological types on the CNF: (1) fish community species composition and relative abundance; (2) macroinvertebrate community structure; (3) water quality conditions.
		2.1.8.2. Contribute to watershed and river basin assessments and monitoring. Develop a complete synopsis of aquatic ecological types and reference site conditions by 2007 and incorporate them into watershed and river basin assessments, such as the White Oak River Basin assessment.
		2.1.8.3. Determine the distribution and relative abundance of anadromous fish species. Inventory 5 miles of stream each year for anadromous fish occurrence. Coordinate the surveys with the National Marine Fisheries Service and the North Carolina Wildlife Resources Commission.
		2.1.8.4. Restore the natural hydrologic flow on about 2,300 acres where former wetlands were ditched and drained.
		2.1.8.5. Maintain 36 miles of non-acidic freshwater streams to support largemouth bass populations, 32 miles of acidic freshwater streams to support redbfin pickerel populations, 16 miles of brackish streams to support chain pickerel populations, and 2,800 acres of lakes.

2.2 Recreation Opportunities:

Issue	Goal/Desired Condition	Objectives
<p>Issue #1: Increase Recreation Opportunities</p> <p>Settings for the types of nature-based recreation enjoyed on national forests range from primitive to highly developed. Desires of traditional local users of a forest often differ from those of new recreationists attracted by a growing tourism industry. To what extent should recreation opportunities focus on hunting, fishing and other wildlife-related activities? What location can be used by off-highway vehicles without extensive damage to other natural resources?</p>	<p>2.2.1. Provide a wide range of safe and enjoyable recreation opportunities focusing on water, with settings varying from rustic and natural to more developed. Accommodate the varied ability levels of forest visitors at developed sites. Provide a system of marked recreational trails and support facilities to promote a variety of experiences for both motorized and non-motorized trail users. Minimize the impacts to natural resources from recreation activities. Support the maintenance of facilities and trails in part by user fees, and cooperative agreements for volunteer maintenance.</p>	<p>2.2.1.1. Use Infra/Meaningful Measures inventory and Meaningful Measures Costing information to help prioritize and plan work to carry out the recreation program.</p>
		<p>2.2.1.2. Increase the capacity for recreation sites that are highly developed with many amenities (Rural ROS class) by 15 percent. Increase capacity for moderately developed water-based recreation sites with natural-appearing settings (roaded-natural ROS class) by 40 percent.</p>
		<p>2.2.1.3. Increase capacity for rustic developments in natural appearing water-based sites (semi- primitive motorized ROS class) by 50 percent. Construct a group camp at Cedar Point.</p>
		<p>2.2.1.4. Over the next 3 years, sign and mark trail systems. Some trails may be shared among several user groups, and other trails will be designated for a single activity use. Work with user groups to identify potential locations for designating additional equestrian and bike trails, emphasizing opportunities for loop routes using existing trails and gated classified roads. Develop a horse trail of 10-20 miles (may require some new trail construction). Develop a bike system of 20-40 miles. Develop with partners a scenic byway and historic driving tour on the forest.</p>
		<p>2.2.1.5. Continue OHV use in the designated Black Swamp OHV area. Work with user groups, such as hunters and OHV-riders, to monitor and evaluate the Black Swamp Area for opportunities to enhance or improve existing routes, re-designate routes, expand routes, close routes, or a combination of these actions.</p>

2.2 Recreation Opportunities (continued):

Issue	Goal/Desired Condition	Objectives
Issue #2: Expand Hunting, Fishing, and Wildlife-Related Recreation Opportunities <i>To what extent should recreation opportunities focus on hunting, fishing and other wildlife-related activities?</i>	2.2.2. Provide for a range of compatible and accessible wildlife-related recreation opportunities to accommodate current and projected public demands.	2.2.2.1 Catfish Lake Impoundment: Complete the implementation plan to include: <ul style="list-style-type: none"> • Construction of one wetland wildlife-viewing platform that is accessible to users with disabilities, and contains interpretive wayside exhibits. • Expanded parking facilities. • Construction of one waterfowl hunting blind and access bridge that is accessible to hunters with disabilities.
		2.2.2.2 Wildlife Viewing Opportunities and Interpretations: <ul style="list-style-type: none"> • Develop two wildlife-viewing trails in the Brice Creek and Cahooque Creek/Pine Cliff Areas with interpretation. • Construct one wetland wildlife viewing blind and access bridge that is accessible to users with disabilities.
		2.2.2.3 Hunting Opportunities: <ul style="list-style-type: none"> • Utilize universal design principles to develop opportunities such as turkey hunting blinds, deer hunting stands, dove hunting blinds, access bridges across drainage canals, and access trails to make the Forest as accessible as possible to all hunters. • Provide opportunities for walk-in hunting away from easy access by vehicles.
		2.2.2.4 Fishing Opportunities: <ul style="list-style-type: none"> • Establish new fishing opportunities. Create three small lakes (minimum of 3 acres each) to manage intensively for high angler success and use for special events such as fishing rodeos and conservation education events. • Develop low-impact bank fishing trails and canoe ways on high-quality streams such as Brice and Hunter Creeks. • Monitor in-stream habitat conditions and improve habitat as necessary to maintain strong populations of sport fish species. • Favor the use of native fish species when creating fishing opportunity.

2.3 Special Land Allocations:

Issue	Goal/Desired Condition	Objectives
<p>Issue #1: Wilderness <i>Land on the CNF has been, and could be, allocated for wilderness. Congressional designation is required for wilderness. Since allocation of an area as wilderness precludes its use for certain other purposes, special allocation must be done with great care. The extent to which currently designated wilderness will be expanded needs exploration. How should the Forest Service manage these areas to retain the unique values inherent to their potential designation whether official recognition occurs or not?</i></p>	2.3.1.a. Protect and enhance the unique attributes and characteristics of Sheep Ridge, Pond Pine, Pocosin, and Catfish Lake South Wildernesses. Retain the values that large, intact areas of relatively undisturbed pocosin add to the richness and diversity of the region and the CNF.	2.3.1.1. Recommend three roadless areas as wilderness: Catfish Lake South Additions A & B and Pocosin Addition. These areas total approximately 691 acres.
	2.3.1.b. Enhance opportunities for visitors to experience primitive recreation and solitude with a minimum of restriction. Emphasize leave-no-trace principles for wilderness visitors. Encourage visitors not desiring a wilderness experience to use less primitive areas of the Forest.	2.3.1.2. In cooperation with user groups, construct hiking and horse trails in some portions of established wildernesses where practical and wilderness values can be sustained.
	2.3.1.c. Enhance opportunities to interpret the ecological and scientific values of the wildernesses. Provide off-site interpretive material that explains the unique attributes of pocosin ecosystems.	2.3.1.3. Install signing and sign-in boxes at trailheads or road ends that access the wildernesses that describe the area and the trails that are available.
	2.3.1.d. Enhance opportunities for ecological systems to function as freely as possible. Modify over time those conditions that are presently constraining natural systems, such as invasive species and unnatural fuel loading, to enhance the natural integrity of each wilderness.	2.3.1.4. Develop a Wilderness Implementation Schedule (WIS) that provides priorities for management activities in each Wilderness.
		2.3.1.5. Identify cultural and ecological constraints on fire operations in each Wilderness. Wildland-Urban Interface areas within Wilderness will be a priority for fuel reduction.

2.3 Special Land Allocations (continued):

Issue	Goal/Desired Condition	Objectives
<p>Issue #2: River Corridors Eligible for Wild and Scenic River Status <i>Land on the CNF could be allocated as a wild and scenic river with Congressional designation. Since allocation of an area as a wild and scenic river precludes its use for certain other purposes, special allocation must be done with great care. A recommendation for the White Oak River and Brice Creek to be designated as wild and scenic depends on the resource values present, the amount of local public and political support, and the extent of National Forest land bordering the corridors of the waterways. How should the Forest Service manage these areas to retain the unique values inherent to their potential designation whether official recognition occurs or not?</i></p>	<p>2.3.2. Retain the outstandingly remarkable values for scenery, fish and wildlife habitat, and historical and archeological resources, their free flowing condition, and natural settings that make the White Oak River and Brice Creek eligible for wild and scenic river status.</p>	<p>2.3.2.1. Manage a ¼ mile corridor along the portions of White Oak River and Brice Creek that are National Forest to retain and enhance the outstandingly remarkable values for which they are recognized.</p>
		<p>2.3.2.2. Recommend to the State of NC that the White Oak River and Brice Creek undergo further evaluation to determine suitability for Congressional designation as Wild and Scenic Rivers.</p>
		<p>2.3.2.3. Manage potential wild segments at a semi-primitive non-motorized ROS class, potential scenic segments at a semi-primitive motorized or semi-primitive non-motorized ROS class, and potential recreational segments in a roaded natural or semi-primitive motorized ROS class.</p>

2.4 Silviculture, Forest Products, and Forest Health:

Issue	Goal/Desired Condition	Objectives
<p>Issue #1: Restore Longleaf Pine <i>Concerns about ecosystem health, biological diversity, and rare species and communities have created demands to change existing forest types. Re-establishment of longleaf pine appears to be necessary for red-cockaded woodpecker recovery in the area, and some clearcutting and seedling planting may be needed to accomplish this objective. However, public opinion is divided on the idea of clearcutting loblolly pine and planting longleaf pine. Another issue is what land is suitable for timber production on the CNF. Such a determination is required by law.</i></p>	<p>2.4.1.a. Use the ecological classification to guide restoration efforts for desired species composition and maintain forest health by managing for species that are adapted to local disturbances, such as hurricanes, fires, and bark-beetle attacks. The priority for restoration of stands includes</p> <ol style="list-style-type: none"> 1) Inactive and active RCW forage territories that lack longleaf pine, 2) Mature loblolly pine stands, around 80 years old, that have a component of longleaf pine that could be retained using the shelterwood with reserve trees system, 3) Off-site loblolly plantations, 4) Mature loblolly pine stands, around 80 years old, more suited to mixed pine (longleaf, pond, and loblolly) composition within inactive RCW territories greater than ½ mile from active territories, and 5) Where sensitive species would benefit from restoration activities. <p>2.4.1.b. Use a range of regeneration methods that are site-specific, efficient, and scientifically based.</p> <p>2.4.1.c. Use efficient timber stand improvement treatments, such as prescribed fire, to ensure growth and development of seedlings.</p> <p>2.4.1.d. Manage for high-quality pine sawtimber on land suitable for sustained timber production by maintaining growth and development through intermediate harvests.</p> <p>2.4.1.e. Use salvage timber sales to remove damaged pine, to reduce risk of bark beetle infestation to healthy trees, and to reduce fuel loading. Where appropriate, restore damaged loblolly pine stands to longleaf pine.</p>	<p>2.4.1.1. Regeneration:</p> <ul style="list-style-type: none"> • Restore longleaf pine on 1250-1750 acres (10-year period) using the shelterwood with reserve trees method where the probability of successfully regenerating longleaf pine is moderate to high. Retain the longleaf component during regeneration, and supplement natural regeneration with planted longleaf pine if necessary. The desired condition is 150-250 longleaf seedlings per acre, free of competition, evenly distributed across the area, 5 years after harvest. • Restore longleaf pine on about 500-750 acres (10-year period) by clearcutting and planting longleaf pine seedlings. Emphasize the least intensive site preparation required to meet Silviculture objectives (see Appendix E for description of site preparation techniques). Current stocking is primarily loblolly pine. The desired condition is a minimum of 300 longleaf seedlings per acre, free of competition, evenly distributed across the area, 5 years after harvest. • Restore longleaf pine on 900-1100 acres (10-year period) in off-site loblolly plantations by cut and leave method and prescribed burning. The desired condition is 20-40 sq. ft. basal area of longleaf pine and 100-150 longleaf pine seedlings per acre evenly distributed across the area.
		<p>2.4.1.2. Intermediate Harvests:</p> <ul style="list-style-type: none"> • Thin 3200 acres (10-year period) to maintain stocking levels suitable for RCW habitat requirements and to maintain healthy stands that minimize risk of bark beetle infestations. The desired condition is healthy stands free from bark beetle infestations, suitable for RCW foraging in the habitat management area. • Thin 1000 acres (10-year period) on sites currently stocked with loblolly pine that have a landtype of stream and river terraces or drainage slopes (03). These thinnings will favor existing hardwood component. The desired condition is to shift species composition to achieve a larger hardwood component. • Annually salvage acres damaged due to bark beetle infestations, wind events, and other disturbances. The desired condition is to minimize risk of large bark beetle infestations in pines.

2.4 Silviculture, Forest Products, and Forest Health (continued):

Issue	Goal/Desired Condition	Objectives
<p>Issue #2: Sustain Pine Straw Production.</p>	<p>2.4.2. Provide for sustained pine straw production on 600 acres of longleaf pine sites away from rare species populations with a landtype of mesic savannas and flatwoods (10), or dry-mesic savannas (11). Maintain sparse understory conditions, minimizing occurrence of woody vegetation. Maintain site productivity with periodic applications of fertilizer.</p>	<p>2.4.2.1 Manage a total of 600 acres for sustained pine straw production, using a rotating cycle of harvesting, burn and rest, and fertilizing:</p> <ul style="list-style-type: none"> • Harvest pine straw on 200 of these acres each year. • Burn 200 acres each year to maintain sparse understory conditions. • Rest 200 of these acres from pine straw production each year. • Based on soil tests, fertilizer will be applied if needed.

2.5 Fire Management:

Issue	Goal/Desired Condition	Objectives
Issue #1: Reduce Wildfire Related Risk <i>Historically, fire has been the primary natural disturbance to the ecosystems of the CNF, and therefore plays a vital role in the management of these ecosystems. Fire also helps to limit hazardous levels of fuels. Questions surrounding the appropriate use of prescribed fire need to be addressed. How much prescribed fire will reduce the risk of wildfire in wildland-urban interface areas? What other treatments may need to be used to reduce fuel loading to a safe level before prescribed fire can be used?</i>	<p>2.5.1.a. Sustain a Fire Management Program that provides for the health and safety of employees and the public, while minimizing the risk of wildfire, and ensuring the optimum use of fire as a management tool. Develop and maintain a current Fire Management Plan that outlines the fire program, including the operational use and suppression of fire on the Croatan National Forest.</p> <p>2.5.1.b. Reduce the risks and consequences of wildfire through fuel treatments. Reduce fuel loads to allow lightning-caused fire to function, as much as possible, as a natural process.</p>	<p>2.5.1.1 Provide for human health and safety, determine values at risk, and minimize damage to resources.</p>
		<p>2.5.1.2 Reduce extreme fire behavior characteristics and spotting distances to create a defensible space in areas designated as having high potential risk (approximately 5355 acres and identified as the Wildland-Urban Interface). The width of the treated area is dependent on conditions within a ¼ mile wide zone.</p>
		<p>2.5.1.3. Reduce fuel loads to aid in wildfire suppression with a prescribed fire program:</p> <ul style="list-style-type: none"> • A 5-12 year rotation in 25,000 acres of pocosin ecological types within previously burned fire compartments (see Appendix B); as research results become available, expand the use of fire in an additional 48,000 acres of pocosin. No new fire plowlines will be allowed along savanna-pocosin ecotones. • A 3-5 year rotation in 22,500 acres of mixed pine and pond pine woodland ecological types in previously burned fire compartments (see Appendix B); as wildfire risks are reduced in adjacent stands, expand the use of fire in an additional 19,000 acres of mixed pine and pond pine. • A 2-4 year rotation in 21,000 acres in longleaf pine ecological types in previously burned fire compartments (see Appendix B); expand the prescribed burning program to include an additional 5,500 acres of longleaf pine. No new fire plowlines will be allowed along savanna-pocosin ecotones. <p>This program includes burning for silvicultural purposes. Burning rotations may change during site preparation but will return to rotation cited above within a 10-year period. The program also includes WUI acres, but these fuels may be treated by methods other than prescribed fire.</p>
		<p>2.5.1.4. Maintain the most efficient level of staffing to meet fire program management and implementation needs based on the most current approved Fire Management Plan.</p>

2.5 Fire Management (continued)

Issue	Goal/Desired Condition	Objectives
<p>Issue #2: Expand the Role of Prescribed Fire <i>Historically, fire has been the primary natural disturbance to the ecosystems of the CNF, and therefore plays a vital role in the management of these ecosystems. Questions surrounding the appropriate use of prescribed fire need to be addressed. What is the optimum amount and timing of prescribed burning that is needed to meet vegetation management goals?</i></p>		<p>2.5.2.1. <i>Longleaf Pine:</i></p> <ul style="list-style-type: none"> • Apply fire to 2750-3500 acres to reduce woody vegetation and logging debris for seedbed preparation of pine stands. • Burn once while longleaf pine is in the grass stage. • Burn on a 2- to 4-year rotation with growing season fire after longleaf pine seedlings are out of the grass stage and greater than 4 feet in height. • Use growing season fire to create open, park like understory conditions.
	<p>2.5.2.a. Use prescribed fire to restore the structure and composition of longleaf and mixed pine, prepare seedbeds for longleaf pine restoration, control competing pine species, and improve existing longleaf pine stands. Improve browse, open understory conditions and maintain mast production for black bears, turkeys, and white-tailed deer using techniques that will create mosaic burning patterns.</p>	<p>2.5.2.2. <i>Wildlife & Threatened and Endangered Species:</i></p> <ul style="list-style-type: none"> • Allow fire to burn in a mosaic pattern, and, where possible, maintain hardmast producing trees and shrubs. • Develop a site-specific plan for fire use in the Millis Road Savanna Registered Natural Area. • At Millis Road Savanna Natural Area, burn adjacent fire compartments (see Appendix B) on an alternating 3-year cycle. Do not burn adjacent fire compartments (see Appendix B) within 3 years of each other. • Use fire to improve habitat for threatened and endangered species.
	<p>2.5.2.b. Expand the role of fire to recover and sustain short interval fire-adapted systems.</p> <p>2.5.2.c. Develop a Fire Use Program for the CNF that would allow natural ignition to be used as a tool to achieve desired conditions.</p>	<p>2.5.2.3. <i>Fire Use Program:</i></p> <ul style="list-style-type: none"> • Restore fuel loading to levels that allow fire to burn without causing undesired impacts (e.g. soil sterilization, stand replacement). • Prepare a Fire Use Plan for natural ignition, and a Prescribed Fire Plan for management ignited fires, for those areas on the CNF that utilizes fire as a tool for ecological restoration. • Use natural ignition fires to restore ecosystem structure and function to a condition that is more similar to presettlement conditions.

2.5 Fire Management (continued)

Issue	Goal/Desired Condition	Objectives
<p>Issue #3: Maintain Air Quality</p> <p><i>Historically, fire has been the primary natural disturbance to the ecosystems of the CNF, and therefore plays a vital role in the management of these ecosystems. Fire also helps to limit hazardous levels of fuels. Questions surrounding the appropriate use of prescribed fire need to be addressed. If prescribed fire is increased, how will air quality standards be maintained?</i></p>	<p>2.5.3. Increased prescribed fire activity on the forest will not result in a violation of any National Ambient Air Quality Standard. Also, there will be no increase in the number of vehicle accidents related to smoke/limited visibility, or the frequency at which mitigating measures are implemented to prevent a vehicle accident.</p>	<p>2.5.3.1. Ignite prescribed fire when the burning conditions and atmospheric conditions will lift and disperse the smoke. Select only those days that have adequate smoke dispersal characteristics to minimize the likelihood of vehicle accidents, or violations of any National Ambient Air Quality Standard.</p>

2.6 Access:

Issue	Goal/Desired Condition	Objectives
<p>Issue #1: Providing access while protecting natural resources.</p> <p><i>Balancing reasonable public access with protecting natural resources is a critical challenge for national forest management. Too much access causes problems with trash dumping, illegal shooting, user conflicts, negative impacts to wildlife, unauthorized use of closed roads, resource damage, and the creation of new trails and roads. High levels of access also increase the cost to maintain roads to an adequate and safe standard. However, limiting access too much restricts the public from through roads, and from using the national forest in ways that they enjoy such as biking, hunting, bird watching, OHV-riding, and camping.</i></p>	<p>2.6.1.a. Close unauthorized routes and some classified roads to reduce safety risks resulting from unregulated shooting and dumping. Reduce opportunities for illegal trash disposal by focusing road closures on dead-end roads. Reduce the impacts of unauthorized and illegal access with effective methods such as closing these routes with gates or ditching. Enhance black bear and wild turkey habitat by reducing motorized access to core areas.</p>	<p>2.6.1.1. Close at least 15 to 20 miles of open roads over the next 10 years. Schedule road closure at the rate of approximately 1 to 2 miles per year.</p>
		<p>2.6.1.2. Close unauthorized routes over the next 10 years, and restore to the ecological landtype. Those routes that are least expensive to close should be first priority.</p>
	<p>2.6.1.b. Access to most recreation places and some hunting grounds will be maintained. However, motor-vehicle access will not be provided to every place on the forest.</p>	<p>2.6.1.3. Manage an additional 15 to 20 miles of open roads using seasonal closures.</p>
	<p>2.6.1.c. Maintenance funds will be concentrated on fewer open roads, so those roads will be improved. Focus maintenance funds on roads in disrepair with high-use traffic patterns.</p>	<p>2.6.1.4. Clean up trash, beginning first with areas posing a threat to public safety. The second priority for cleanup is SIAs.</p>

2.7 Local Communities:

Issue	Goal/Desired Condition	Objectives
Issue #1: Adjust Land Ownership <i>The Croatan National Forest comprises approximately 14.6% of the land base in the 3 counties in which it exists. Managing this much of a county's land base requires close contact with local communities and governments. The interactions between the Forest Service and local communities can include exchanging or acquiring land. As the local communities grow, demands for such interactions multiply. Providing for compatible and complementary uses and values is essential for forest sustainability and community vitality. What opportunities exist for enhanced collaboration with and continued support for local communities?</i>	2.7.1. Acquire land or interests in land needed to support natural resource management and recreation objectives. Consolidate national forest holdings to improve efficiency and enhance public benefits. Exchange or transfer land to consolidate or provide public benefits. Acquire rights-of-way or fee simple titles to meet access needs. Use purchase, donation, exchange, right-of-way acquisition, transfer, interchange, and boundary adjustment to consolidate ownership pattern, to mitigate for wetland drainage, and to provide linkages to other biologically significant areas, such as Marine Corps Air Station Cherry Point, Hoffman Forest, and Marine Corps Base Camp Lejeune. Support other organizations that acquire conservation easements when the easement is on property that would enhance National Forest management.	2.7.1.1. Acquisitions will focus on acquiring land that has been identified in the land adjustment plan for resource and recreation management areas. High priorities will be placed on the acquisition of land in the White Oak River and Brice Creek corridors; to providing linkages to other land in conservation management; in areas adjacent to Congressionally designated areas; and in other riparian ecosystems. Land identified for acquisition for the consolidation of national forest ownership will be considered only when other resource objectives have been met.
		2.7.1.2. If funds are available, acquire 9,000 acres over the next 10 years. That area is approximately 20 percent of the available land base identified in the land adjustment plan in priority areas.
Issue	Goal/Desired Condition	Objectives
Issue #2: Special Uses <i>Interactions between the Forest Service and local communities can include issuing special use permits. As the local communities grow, demands for such interactions multiply. Analyzing whether uses are compatible with National Forest management is vital to providing a sustainable forest and positive community relationships.</i>	2.7.2. Manage special uses of CNF land in a manner that protects natural resource values and public health and safety, while meeting land and resource management objectives. Administer special uses that are compatible with natural resource management objectives and sound business management principles.	2.7.2.1. Focus on the administration of existing permits to meet Forest Service regulatory standards.
		2.7.2.2. Carefully evaluate new uses prior to authorization in areas that have a high density of existing uses. Limit additional permits to uses that clearly serve an overall public benefit and are compatible with existing permitted uses.

2.7 Local Communities (continued)

Issue	Goal/Desired Condition	Objectives
<p>Issue #3: Contribute to Sustaining Local Communities <i>Managing the CNF requires close contact with local communities and governments. The diverse population dynamics of the local communities surrounding the CNF presents a challenge in developing collaborative partnerships. Providing for compatible and complimentary uses and values is essential for forest sustainability and community vitality. What opportunities exist for enhanced collaboration with and continued support for local communities?</i></p>	<p>2.7.3.a Provide opportunities for the local populations to develop a unique connection - a sense of place – to the CNF.</p> <p>2.7.3.b. Work collaboratively with local governments to identify complementary goals for land management and to seek input on implementation of the CNF Plan's goals and objectives.</p> <p>2.7.3.c. Provide information about the natural and cultural environment to foster understanding of the uniqueness of the CNF, and to help develop ecological-based tourism.</p> <p>2.7.3.d. Collaborate with local entities to create defensible space (as it relates to wildfire), and to inform about the use of fire.</p>	<p>2.7.3.1. Develop action plans with local communities and governments to sustain the places and features that make the area unique.</p>
		<p>2.7.3.2. Sponsor special events in conjunction with local communities to help develop sense of place with population segments.</p>
		<p>2.7.3.3. Manage, protect, preserve and interpret heritage resources. Encourage scientific research at sites.</p>
		<p>2.7.3.4. Develop informational material on the natural resources on the CNF, such as fisheries and aquatic habitats, for visitor stations, schools, retail stores and government offices.</p>
		<p>2.7.3.5 Provide information and assistance to local communities on creating defensible space (as it relates to wildfire), on understanding the use of fire, and on other national fire initiatives and opportunities.</p>

This page intentionally left blank.

Chapter 3: Prescriptions: Management Of Key Landscape Features, Conditions, & Uses

3.1: Introduction

Certain key features of its landscape determine the character of the Croatan National Forest (CNF) and the benefits people can enjoy there. Examples of such features include lakes, rivers, hardwood wetlands, and pocosins. This chapter describes the ways in which the Forest Service proposes to manage these key features.

For each type of feature, an ideal or “reference condition” is described. The reference condition is meant to describe what the desired effect of management will achieve. Since no two sites or features are identical, an attempt is made to show how features may vary from reference conditions. Therefore, the reference is one within a range of conditions. The range exists due to differences in the initial conditions’ site capability and responses to management for each site. Sometimes reference conditions cannot always be achieved due to natural disturbances, such as hurricanes and wildfires, or human influences, such as developed sites.

For each type of landscape feature, the management practices that may be encountered during a visit are listed. These lists are not meant to be all-inclusive but, instead, are intended to help communicate the kinds of activities for each prescription. Within these prescriptions, finer scale features are recognized; smaller land features and management emphases for them are embedded in the larger landscape prescriptions. For example, of RCW-HMA is a broad scale management prescription, and within this prescription lies the finer scale longleaf old growth. Where embedded prescriptions apply, the more restrictive prescription should be enforced, except where Special Interest Areas overlap with Wilderness Areas. In those cases wilderness prescriptions will apply.

Table 3.1 shows the amount of finer-scale embedded prescriptions within the broader scale landscape prescriptions. SIAs both for natural areas and heritage resource areas, and old growth are the embedded prescriptions.

Table 3.1 Prescription Matrix

Management Prescriptions	Approximate Acres	Embedded Prescriptions (acres)		
		Special Interest Areas (natural areas)	Special Interest Areas (heritage resources)	Designated Longleaf Old Growth
Pocosin Lake Management	4,900	4,900	0	0
Wilderness Management	32,000	31,420	0	90
River Corridors Eligible for Wild & Scenic River Status Management	3,400	30	1,450	20
Hardwood Cypress Wetland Management	8,300	1,085	895	0
RCW Habitat Management Area ¹	64,650	7,685	2,030	1,705
Wildland-Urban Interface Management ¹	2,350	0	0	0
Upland Hardwood Management	1,700	0	0	0
Black-Bear Habitat Management	38,760	5,330	150	0
Developed Area Management	2,160	265	305	0
Off Highway System Management	3,200	0	0	0
TOTALS	161,420	50,715	4,830	1,815

¹ Portions of the entire RCW HMA prescription overlap with other management prescriptions such as Wilderness. The 4650 acre overlap brings the total acreage for the RCW HMA to 69,300 acres. In a similar manner, portions of the entire Wildland Urban Interface also overlap with other management prescriptions, primarily Wilderness. The 3005 acre overlap makes the total acreage for WUI 5355 acres. The actual locations of the overlap are documented in the process record.

3.2: Pocosin Lake Management

Pocosin lakes, also known as peat lakes, are numerous on the CNF. However there are three major lakes, Catfish, Great, and Long Lakes. All combined these larger lakes occupy an area of 4,900 acres. Pocosin lakes are unique because of their shallow depth, acidic water chemistry, dark colored water, and source of new water. Pocosin lakes on the Croatan National Forest are mainly precipitation fed. The lakes support aquatic life with a specific niche.

Reference Condition: Great Lake was selected as the reference condition. Great Lake, covering approximately 2,000 acres, is an area of water inside a pocosin wetland. It is shallow, averaging less than 4 feet in depth throughout its area. The lake was formed approximately 6000 years ago (Trapani 1998). The lake functions like a cistern, capturing water from precipitation and releasing it slowly into streams. Water from the lake also leaches into adjacent land helping to create the wetland environment. The water is relatively free of toxic contaminants and has a high-water quality rating. The lake is dystrophic, has low nutrient levels, and is brownish due to dissolved humic matter. The lake is also acidic, with pH values less than 4.0 (DENR, 1990). While the water supports fish, such as largemouth bass, fewer species are found here than in water with higher pH.

Vegetation along the edge of Great Lake is a mixture of short and tall pocosin, gum swamp, bay forest, and pine forest. In the future, tall pond pines may dominate the

lakeshore, with patches of hardwoods and Atlantic white cedar providing potential roost habitat for bird species such as the bald eagle.

The elliptical shape, the wide water surface, and the surrounding undisturbed shores create a scenic setting that draws recreationists interested in exploring remote environments. A boat launch provides access for small motorboats and non-motorized watercraft. A spur road adjacent to the boat ramp provides camping opportunities in an almost primitive context.

Visitors experience a sense of isolation from the sights and sounds of human disturbances and activities. Wilderness surrounds one-half of the lakeshore with the remaining portion being roadless pocosin. Access is from one gravel road, and although motorized use is allowed on the lake, motor size is restricted. These restrictions help maintain a feeling of solitude compatible with wilderness.

Variation from Reference Condition: Differences in pH and nutrient levels may cause fish populations to vary in the lakes. The experience of solitude will vary depending on the time of visit. During holidays, the experience of solitude may be diminished due to very high recreation use.

Probable Management Practices:

- Maintenance of the boat launch and construction or reconstruction of facilities.

Embedded Prescriptions: Approximately 4,897 acres of SIA (natural areas) are embedded within Pocosin Lake Management Area.

3.3: Wilderness Management

This prescription includes the congressionally designated Wildernesses of Catfish Lake South, Pocosin, Sheep Ridge, and Pond Pine. Wildernesses are managed to perpetuate their natural conditions while providing for recreational, scientific, scenic, educational, and conservation uses that are compatible with Wilderness values and attributes. Natural processes are allowed to operate as freely as possible and human impacts are substantially unnoticeable.

Reference Condition: Catfish Lake South was chosen as a reference condition for wildernesses. It exceeds the minimum 5,000-acre size criterion for wilderness with 8,530 acres. This wilderness is one of the best examples of undisturbed pocosin community types. Its wetland areas are characterized by organic peat accumulations and nutrient-poor soils, and vegetation includes combinations of semi-evergreen shrubs and scattered pond pine.

Composition and height of these species vary with frequency of fire, depth of the water table, and nutrient content of the soil. In several places, sand ridges rise above the surface of the peat deposits, and Catfish Lake, on the eastern boundary, empties into the peat bogs. This wilderness has little evidence of human disturbance, except for the lack

of fire resulting from human interference in the form of aggressive fire suppression. Natural processes such as flooding, hurricanes, tornadoes, and fires shape vegetation. Wildlife species are protected from human disturbance. Large areas of uninterrupted habitat provide a safe haven for animals like the black bear. Soil, water, and air are free of pollutants.

Catfish Lake South Wilderness area has a center core that is extremely isolated from human activities. Due to the dense vegetation and tangled underbrush, other people are encountered on a very limited basis. This isolation gradually lessens as a person moves towards the edges of the wilderness and encounters more human activity. Roads border three sides of Catfish Lake South. One of these, Catfish Lake Road, has traffic levels exceeding 500 cars per day.

Visitors to the area include hunters, nature enthusiasts, boaters, anglers, hikers, and horseback riders. No facilities are present other than an occasional fire ring. Motorized or mechanical vehicles, and motorized equipment are not encountered. Information and signing is not provided within the wilderness boundary.

Variation from Reference Condition: When designated in 1984, Catfish Lake South Wilderness included a canal near Catfish Lake Road, and several old fire plowlines. No logging has occurred in this area since the national forest was established in 1933. However, arrangement of trees in rows in plantations may be seen at close range. Fuel loading is heavy due to rapid suppression of all fires regardless of ignition source.

Military low-level flights and motorized boat use on the lakes sometimes break the solitude experience of the wilderness. Facilities encountered are primitive boat access sites and fire-ring camping areas at the lakes. Many wildernesses have short spur roads into them or to a destination, such as a lake. These short roads and cross-country travel provide the only access into the areas.

Probable Management Practices:

- Hiking trails may be built to access some areas' interiors.
- Boundary and trailhead signs and other information for wilderness users will be provided. Erecting gates or dirt berms may restrict motorized vehicle access around the shoreline of Great Lake.
- Various methods may be utilized to decrease fuel loading and subsequently maintain the fuel accumulations at a level that allows for the possibility of using and/or allowing fire within the Wilderness without threatening adjacent areas. Mechanical treatments may be one of the methods used to reduce fuel accumulations. The Minimum Requirement Decision Guide (Arthur Carhart National Wilderness Training Center 2002) will be used to identify the most effective, lowest impact method.
- Plowed firelines may be used to aid in wildfire suppression under extreme conditions.
- A Fire Plan will be developed to guide fire operations while maintaining wilderness values. Biological, cultural and wildland urban interface conditions

may place constraints on fire operations in Wilderness. Any site-specific constraints will be identified in the Fire Plan.

Embedded Prescriptions: Approximately 31,936 acres of SIA (natural areas), and 91 acres of old-growth longleaf patches are embedded in the wilderness prescription.

3.4: River Corridors Eligible for Wild & Scenic River Status Management

Wild and scenic rivers are segments of watercourses that are designated and added to the national system because they contain natural, cultural, scenic, and recreational values that are outstanding for their particular geographic area. By designating them wild and scenic rivers, their outstanding values are retained and enhanced on national forest system land. Two rivers, White Oak and Brice Creek (which includes portions of East and West Prong Creeks), were evaluated in this planning process to see if they should be designated. There are three categories for designation, each of which carries certain restrictions. The categories (wild, scenic, and recreational) are based on the quality of natural resources and the degree that human activities have changed the natural character of the area. A wild segment shows little human impact and has many restrictions on the types of activities that will be allowed on that segment of river. A recreational segment shows many signs of human activities and has fewer restrictions. The scenic designation falls between the two. The portion of a river that is evaluated includes 1/4 mile on either side of the river and whatever river length is appropriate to retain the values.

Reference Condition: The White Oak River was chosen as a reference condition for rivers eligible to be designated as part of the national wild and scenic river system. The river is a predominantly blackwater coastal river that drains swampy or marshy areas of the interior pocosins to the brackish bay at Bogue Sound. A person traveling the river would move through a variety of landscapes, starting at the mouth with saltwater marsh that is broad and sluggish and lined with cord grass, up the narrow and meandering river through stands of large hardwood and pines and hardwood swamp.

The White Oak River has eligible scenic and recreational segments along its approximately 30-mile stretch from the headwaters by Hoffman Forest to just south of Hunter Creek by Stella. Along eligible scenic segments, the shoreline is mostly undeveloped, but there is access by gravel roads or trails or rustic developments like the boat launch at Long Point and Haywood Landing. Located along eligible recreation segments are more development and higher standard roads, with much evidence of human activity like the Highway 17 bridge at Belgrade and agriculture fields to the south.

Visitors use the river primarily for recreational activities, such as boating, fishing, and wildlife viewing. In scenic segments, they would be likely to encounter people walking or motoring along the shoreline. In recreation segments, many people often use the river at the same time, and developments to facilitate recreation activities may be present in proximity to the river.

Variation from Reference Condition: A power line crosses an eligible scenic segment of the White Oak River. Flooded marl quarries are located in the eligible recreational segment of the White Oak.

Since the White Oak River does not have any segments that qualify as wild, eligible wild segments of Brice Creek will be described as a variation of the White Oak River reference condition to capture this information. Along wild segments, essentially no evidence of recent human activity is present, and access is non-motorized because there are no roads in the area. In wild segments, visitors are often isolated from the sights and sounds of other human activity and encounter few other users. Water quality, at times, may not meet State standards because of agricultural run-off. Eligible scenic segments along Brice Creek have paved roads and small bridges crossing the stream.

Probable Management Practices:

- Construction of foot and canoe trails and small, gravel boat access points along the White Oak River.
- Construction of accessible fishing piers and adjacent parking lots in developed sites within the corridor.
- Interpretation through signing and brochures about the historic, archeological, and natural values of the river corridors.
- Limited and selective removal of logs or structures to facilitate small boat passage.
- Study and possible testing of archeological shell middens and other sites along the river edge.
- Cooperation with the State Natural Heritage Program to further research on unique aquatic qualities of the river.

Embedded Prescriptions: About 30 acres of SIA (natural areas), and 1,447 acres of SIA (heritage resource areas), and 16 acres of old-growth longleaf are embedded in the river corridors eligible for wild and scenic river status prescription.

3.5: Hardwood Cypress Wetland Management

These areas contain bottomland hardwoods, cypress ponds, and linear swamps, with a transition zone of wet upland hardwood slopes arranged throughout. These wetlands are corridors in a matrix of upland pine, mixtures of hardwood and pine, and pocosin habitats. They link the large intact pocosin habitats in the interior of the forest to major adjacent riverine systems, such as the Newport, White Oak, and Neuse Rivers.

The hardwood-cypress wetland management prescription boundary was based primarily on maps of presettlement riverine swamp communities on the CNF (Frost 1996). There are about 7,900 acres of riverine swamp communities on the CNF (Appendix A). Approximately 1,500 acres are included in Wilderness and River Corridors Eligible for Wild and Scenic River Status management prescriptions and 6,200 acres are included within the hardwood-cypress wetland prescription. The hardwood-cypress wetlands prescription also includes about 2,000 acres of types that are more upland adjacent to the

true riverine hardwood system. Areas along Holston Creek are included within the hardwood-cypress wetland prescription. The Hadnot Creek Ponds and Longleaf Pine Woods area (410 acres) are identified in the Plan in the Special Interest Areas management prescription (Chapter 3.12.1).

Reference Condition: Black Swamp Creek is used as the reference condition. Hardwoods dominate the vegetation structure. Baldcypress and swamp tupelo dominate in wet depressions along rivers, creeks, cypress ponds, and along the periphery of large peatlands. Loblolly pine, yellow poplar, swamp black gum, and semi-evergreen bottomland oaks (willow oak, water oak, and laurel oak) dominate the transition zone between the wetter cypress-gum swamps and adjacent uplands. Swamp chestnut oak and cherrybark oak are dominant on swamp chestnut oak flats. On slightly drier soils, wet-mesophytic trees—water oak, yellow poplar, and red maple—may dominate, with a variety of subcanopy trees and shrubs.

The vegetation structure includes a stream with well-defined banks that flatten out into floodplains. The stream, which drains Great Lake, is habitat for fish and other aquatic species. Water is free of chemical contaminants, but the color is dark due to tannin from organic soils in the pocosins. The stream-course is a canoe trail for human travel. Adjacent to the stream are flat wetlands with soils of high organic content. These wetlands function as sinks that capture and store sediments and offer a nutrient-rich environment for vegetation.

Forested stands within the Black Swamp Creek drainage are characterized as “mature,” averaging 70-100 years in age, and 24-36 inches in tree diameter. Tree spacing is variable with patches of dense stands with more than 80 percent canopy coverage. Understory development is varied, depending on local flooding frequency and duration, and on canopy density. Understory shrub and herb density and diversity vary from very sparse in areas of continuous forest canopy, to nearly continuous and dense in gaps created by natural treefall. Dominant canopy trees range from 100-150 feet, forming a somewhat dense and unbroken upper canopy.

In general, hardwood cypress wetland corridors range from 6 to 8 miles in length. Widths vary from 300 feet at upper portions of stream headwaters to 4,400 feet at the confluence of major rivers. High species diversity, varied site productivity, varied midstory and understory conditions, and various levels of moisture support more vertebrate species than are found in upland forests.

Stands with dense upper canopies and open understories provide high-quality habitat for neotropical migratory birds, such as the blue-gray gnatcatcher, and yellow-throated warbler, which forage or nest in the upper forest canopy. Scattered natural treefall gaps cause well-developed understory strata, providing quality habitat for neotropical migratory bird species such as hooded warbler, Swainson’s warbler, and wood thrush, which forage and nest in midstory and understory vegetation.

Medium to large-diameter snags, tree cavities, and den trees are abundant and well distributed, providing high-quality habitat for species such as pileated woodpeckers,

prothonotary warblers, screech owls, black bears, wood ducks, and Rafinesque's big eared bat. Large diameter logs are widely distributed along stream courses and in interior portions of forested stands.

The connective system of forested wetlands and transitional hardwood slopes provide travel corridors for black bears, wild turkeys, and other vertebrates, to move between interior portions of the forest and major riverine systems. Other species benefiting from the hardwood-cypress wetlands prescription include the yellow-billed cuckoo, Acadian flycatcher, wood thrush, red-eyed vireo, and northern parula.

Public users experience a sense of isolation from the sights and sounds of human disturbances and activities. The level of use is low compared to other portions of the forest. Breaks in the forest canopy are widely dispersed and minimal. Open state and county roads, and moderate- to high-use Forest Service roads cross this area infrequently. The roads provide limited access to stream corridors – an average of one access point for every 3 miles – with minimal roadbed widths to minimize breaks in the canopy. Primitive, rustic, and developed boat ramps exist to provide canoe and boating access to major creeks and rivers. Recreation facilities generally are provided for users at the perimeters of the area. ROS class acres are primarily roaded natural and rural.

Evidence of fire activity ranges from rare in wet areas to common on mesic transitional hardwood slopes. Burning prescriptions for mesic sites are designed to maintain hardmast producing hardwood species with relatively open understories.

Variation from Reference Condition: Fire control lines may extend through transitional hardwood slopes to wetlands. Most of these are narrow, leaving the canopy relatively unbroken. Existing low-standard roads cross the corridor, but use of them is infrequent. Storm damage may create openings in the overstory. New land acquisitions or other ownership adjustments may have open overstory conditions as well.

Probable Management Practices:

- Constructing trails for canoe access points, constructing boat launch sites at a roaded natural ROS level.
- Using natural barriers or existing fire plowlines to manage prescribed fire and wildfire.
- Planting hardmast producing hardwoods and baldcypress for restoration.
- Very limited timber salvaging.
- Mowing existing wildlife openings and existing hiking trails.
- Interpreting the hardwood wetland community through signing and/or production of a brochure.

Embedded Prescriptions: About 1,071 acres of SIA (natural areas), 901 acres of SIA (heritage resource areas).

3.6: RCW Habitat Management Area

The RCW Habitat Management Area (RCW HMA) on the CNF along with RCW habitat on Camp Lejeune and Holly Shelter is one of 15 landscapes across the Southeastern U.S. needed to recover the species. The natural range of RCW within this area extends from Virginia to Texas and as far inland as Kentucky. Habitat suitability for RCW throughout this area is variable but has certain common elements. They include an open-pine forest canopy structure and a grass-forb dominated understory composition. The CNF, Camp Lejeune, and Holly Shelter occur in the northern end of the natural range of RCW in the Coastal Plain. This landscape has certain components of forest structure and composition that are unique within the RCW range. These include: 1) open pine savannas dominated by longleaf pine in the overstory and wiregrass in the understory, 2) woodlands and forests with mixed longleaf pine, pond pine, and loblolly pine in the overstory with wiregrass, huckleberry, and blueberry in the understory, and 3) pocosins dominated by scattered pond pine and dense evergreen shrubs.

Technically, the RCW HMA on the CNF consists of an aggregate of RCW groups close enough (not greater than 18 miles separated) to each other to provide significant genetic interchange between the individual groups, ensuring at least short-term viability. It therefore includes all existing active RCW clusters and inactive clusters, and enough suitable habitat (pine and pine-hardwood forest types) for possible reintroduction where the species occurred historically, but no longer exists. The HMA does not include suitable habitat that is separated by 3 miles or more of permanently unsuitable RCW habitat (including lakes, agricultural lands, hardwood forests, and river bottoms).

Although the delineation of the HMA is based on these technical requirements, local landscape conditions and ownership patterns strongly influence the HMA configuration. The CNF proclaimed boundary is approximately 300,000 acres in size but because of large privately owned tracts and small private in-holdings, the USFS administered land within this boundary is only about 161,000 acres. The RCW HMA on the CNF is approximately 69,000 acres in size and is designed within this fragmented landscape.

This landscape is composed of a matrix, patches, and corridors. The matrix is the most dominant portion of the landscape and exerts strong control over the movement of RCW. It is the portion that makes the landscape a single entity. An analogy is that of a freckled faced child: the skin between the freckles is the matrix. The matrix, in most landscapes, exerts strong control over landscape flows (movement of materials, energy, and organisms) because of the connection it provides for other habitats. Patches are areas with relatively homogenous vegetation composition and structure, suitable for RCW, which differ from what surrounds them. Corridors connect similar patches through a dissimilar matrix.

Maintaining a viable population of RCW on the Croatan is dependent not only on having sufficient suitable habitat for nesting and foraging through forest management, but having a suitable spatial mix and arrangements of habitats through time. Therefore, the reference condition for the RCW HMA is described at two scales, the landscape and the stand.

Reference Condition: The portion of the HMA at the southern end of the CNF is used as the reference landscape condition, and Millis Road Savanna, within this zone, is used as the reference stand condition. The landscape structure consists of a matrix of open to moderately dense, low pond pine and shrub pocosin growing in very poorly drained mineral soils. Interspersed within this matrix are medium to large-sized patches of upland pine forests on more well-drained soils that are connected through the pocosin by long, linear sand ridges also dominated by pine forests.

The composition of the uplands is predominately longleaf pine savannas with mixed-pine savannas and flatwoods occurring where there are broad transitions with pocosins. They function as the primary nesting and foraging habitat for RCW in this area. The pocosins function as barriers to the spread of ground fire and to longleaf pine expansion but not to the movement of RCW. The species occasionally forages in the scattered pond pines in pocosins, and the more dense vegetation provides hiding cover for young RCW fledglings and protection from predators. The pocosins also act as reservoirs for wetland species. Longleaf pine savannas on linear sand ridges provide a corridor for RCW movement throughout the HMA and connect the southern and western zones. At a finer scale, this corridor also functions as a passageway for local fires and is able to ignite anywhere along its length. Under a natural fire regime, the system is self-perpetuating; vegetation and community structure created by fire provide the fuels to sustain future fires. The intervening ecotone between the pocosin and upland patches and ridges is extensive and especially diverse, containing numerous rare savanna plant species.

Within the habitat patches and corridors, stand structure is savanna—a fire-maintained community in which a tree layer provides up to 50 percent cover over a continuous, usually grassy, herb layer (Frost, Walker, and Peet 1986). The forest therefore has two distinct layers—a pure longleaf pine canopy approaching 70 feet in height and a wiregrass-dominated herb layer. The fallen needles of longleaf pine and the wiregrass ignite easily and burn rapidly, carrying fire for considerable distances along the long, narrow sand ridges and across the upland patches. The growth of woody pocosin species' is stunted by fire, and their stature is small along the ecotone. At the frequently burned wetland-upland contact is a treeless zone in which the herb layer is species-rich and may contain rare species such as Venus' Flytrap and rough-leaved loosestrife.

Most longleaf pines are nearing maturity, averaging more than 100 years old and 16 to 22 inches in diameter. The canopy is mostly open and park-like but groves of flat-topped trees and 1/10-acre to 1/2-acre groups of young pines break the evenness of the canopy height. There are occasional snags and large logs. Large diameter trees function as nesting habitat for RCWs, while the uneven-aged forest provides foraging habitat and future replacement for canopy dominants. Occasional vehicle tracks and low-maintenance roads run the length of some sand ridges. These roads are service lanes for prescribed burning and other timber stand improvement operations. An occasional fire plowline, used in the past during wildfire suppression activities, can be seen.

Well-traveled roads surround this area, and Millis Road runs through a large segment of pine savanna. There is very little development once off the main roads, so visitors have a

sense of solitude. Hunting is a popular activity and travel off the main roads is by foot along trails or ‘cross-country’. ROS class acres are primarily roaded natural and rural.

Variation from Reference Condition: At the landscape scale, the matrix composition and configuration of patches and corridors within the HMA varies across the CNF. Pond pine woodlands replace pocosin as the predominant matrix in the western and northern portion of the HMA. Mixed pine savannas and flatwoods are more common in these areas and, along with longleaf pine savannas, dominate the suitable habitat patches. Habitat fragmentation is augmented by the expanding urban development in the eastern portion of the HMA. Small pocosins and pond pine woodlands provide the major corridors for RCW movement in this area.

At the stand level, variation from reference condition is more obviously due to differences in management intensity and response to management. Regeneration of young pines may occur in patches ranging from 1 to 25 acres in size although the larger-sized patches are uncommon. Multi-aged stands are more common and have young longleaf pine occurring beneath an open overstory of mature pines. A low to high shrub layer of varying density may be present in stands not yet on a regular prescribed fire rotation.

Probable Management Practices:

- Prescribed burning, timber harvest, and other appropriate methods to maintain stand structure and provide conditions favorable for pine regeneration.
- Road maintenance to provide access.
- Monitoring RCW and savanna indicators to determine management effectiveness.
- Planting longleaf pine to restore pre-settlement species composition.
- Interpreting the significance and management of pine savannas through signing and/or production of brochures.

Embedded Prescription: About 6,384 acres of SIA (natural areas), 2,030 acres of SIA (heritage resource areas), and 1,700 acres of old-growth longleaf forest are embedded in the RCW Habitat Management Area prescription.

3.7: Wildland-Urban Interface Management

Wildland-urban interfaces (WUI) occur where forestland adjoins or mixes with human developments. Most of the perimeter of the CNF either currently is, or has the potential to become, a WUI. To address fire safety within the wildland-urban interface, defensible space can be created that provides a buffer between human developments and forestland. Designating this defensible space and reducing the fuels within minimizes the risk of wildfire and the hazards associated with it.

WUI defensible space offers an opportunity for safer, more successful fire suppression by reducing fire intensity and decreasing rate of spread which in turn decreases the risk to firefighters as well as the risk of damage to nearby structures, improvements and developments.

Since wildfires do not stop at political, jurisdictional, or private boundaries, collaboration among cooperating agencies, local governments, adjoining communities, and private landowners will aim to develop a mutual approach to the WUI. Elements incorporated into WUI treatments may also include signing, and creating adequate road systems and water sources. Public education programs such as 'Fire Wise' may be used to encourage and support local communities with attempts to create defensible space within privately owned areas.

Reference Condition: The reference condition (defensible space) does not fully exist at this time. However, the desired condition is one where the vegetative structure serves as a firebreak as a result of treatments that have reduced the fuels in stature and density. In such areas, fire suppression is likely to succeed, and risks to resources and developments from radiant heat, flying embers and flame impingement are greatly reduced.

In the WUI defensible space, fuels in the shrub layer will be treated to make them discontinuous, with much of the fine dead woody fuel being either removed or compacted. Compaction of fuels along with the reduction in particle size, will provide a more favorable environment for decomposition. Ladder fuels, which carry a fire upward from the surface fuels, will be reduced, as will total fuel loads. Defensible space in pocosins will have a well-defined edge because the continuous shrub layer that once made up the canopy will be broken up through applied treatments. As weather and fuel conditions permit, fire may be applied to some WUI defensible spaces in an effort to meet well-defined objectives.

The WUI will initially have an altered appearance because of clearing and burning activities. The defensible space will increase access for hiking or hunting.

Variation from Reference Condition: The structure and appearance of a WUI defensible space may vary by forest type and pre-treatment fuel conditions. In many cases the canopies will remain relatively closed. Within the pocosin WUI, access will change from occurring along roads and short distances into the pocosin to access through the open space created. Access will eventually end at the edge of the defensible space and the pocosin will remain a remote setting with a feeling of solitude.

Probable Management Practices:

- Mechanical or hand treatments of fuels, which may include cutting, crushing, lopping, and scattering.
- Removal of the shrub layer and aerial fuels may occur. In limited cases, overstory trees may be removed.
- Under specified conditions, fire may be applied.
- Fuels may be treated with foam. Fire plow lines may be constructed where necessary for the safety of firefighter and/or public safety. Where conditions warrant, fixed wing aircraft or helicopters may be used for applications of water or fire retardant, aerial ignition, and reconnaissance.

Embedded Prescriptions: No prescriptions are embedded in the wildland-urban interface prescription.

3.8: Upland Hardwood Management

The distribution of hardwood forest types, which include hardwood forest and hardwood slopes, is determined by a combination of position in the landscape and fire history. These types historically occurred in zones between the frequently burned pine-dominated uplands and the infrequently burned hardwood cypress bottomland.

Reference Condition: Forests in the Hunter Creek area are used as the reference condition. Oaks and other hardwoods are dominant, with pine species occurring as a subdominant canopy component. Hardwood-dominant stands occur in rolling areas near rivers and streams, on steep slopes, at wet toes of gentle rolling slopes, on peninsulas, and on bodies of upland soils surrounded by swamps. Hardwood-dominant types can occur on xeric, dry-mesic, mesic, and wet-mesic sites.

Depending upon landscape position and soils, dominant species include white oak, mockernut hickory, pignut hickory, swamp chestnut oak, cherrybark oak, shumard oak, American beech, yellow poplar, black walnut, bitternut hickory, water oak, laurel oak, sweet gum, green ash, black gum, with a subdominant component of loblolly pine. The subcanopy can consist of flowering dogwood, sourwood, ironwood, southern sugar maple, red maple, hop hornbeam, red mulberry, umbrella magnolia, American holly, and yellow-poplar. Dominant shrubs include beautyberry, spicebush, sweet leaf, dwarf pawpaw, sparkleberry, lowbush blueberry, red bay, *Ilex* species, and red buckeye.

The long-term objectives are to restore natural hardwoods, particularly species that produce hard mast, to areas currently dominated by pine, and to grow these stands to an old age. In the short-term, however, a variety of successional stages and wildlife habitat conditions will be provided as the dominant canopy species shift from pine to hardwood dominance.

Over time, habitat conditions and associated bird species will shift from pine-dependent bird species, to hardwood-woodland dominated types, such as the black-throated green warbler, ovenbird, wood thrush, Kentucky warbler, blue-gray gnatcatcher, hairy woodpecker, black and white warbler, hooded warbler, yellow-throated warbler, yellow-billed cuckoo, red-eyed vireo, and northern parula.

In the short-term, small gaps in the canopy will be created as silvicultural treatments are applied to favor restoration of hardwood hardmast canopy species. The understory will be relatively open, with moderate to sparse shrub and herb layers. Herb and shrub layers will be moderate to dense in hardwood regeneration gaps. However, these gaps will be scattered and generally will comprise less than 25 percent of stands.

Snags, tree cavities, and den trees are abundant and widely distributed through this type, providing habitat for snag- and cavity-dependent species, such as woodpeckers,

nuthatches, eastern screech-owls, barred owls, gray squirrels, southern fox squirrels, raccoons, northern flickers, flycatchers, eastern wood-pewees, Carolina chickadees, tufted titmice, rat snakes, and other reptile species. As stands in this type mature, large logs will become widely dispersed throughout this type, providing microhabitat for small mammals, reptiles, and invertebrates.

Evidence of past and recent fire activity will be less conspicuous than in pine-dominated types. Fire plowlines are evident, but uncommon. Primarily, natural physiographic barriers are used as control lines when available. Prescribed burning will be done mostly in the dormant season, and burns will not be intense.

This landtype provides more visual diversity than other landtypes on the CNF. The desired scenic character is older-aged mature hardwood forest with somewhat open understories. In the short-term, however, viewers will see small openings with dense regeneration interspersed throughout.

Users may have frequent opportunities to observe flocks of wild turkeys searching for insects in grassy openings, because permanent grassy openings may be dispersed throughout. Openings will be frequent in areas designated to provide high-quality turkey habitat.

A variety of recreation opportunities will be accommodated, but non-motorized recreational uses will be emphasized. Public motorized vehicle access will be provided, but the number and density of roads open to public motorized vehicle recreational uses will be less than for other areas on the CNF. Motorized and non-motorized wildlife viewing opportunities will be provided, with an emphasis toward foot and bike travel. ROS class is primarily roaded natural.

To favor wildlife species that are sensitive to human disturbance, road gates and information signs will be erected to restrict certain types of recreational uses on dead-end and spur roads. Non-motorized hunting uses, such as muzzleloader hunting, gun still-hunting, archer hunting, and walk-in spring turkey hunting will be favored.

Variation from Reference Condition: Fire control lines may be maintained in areas. Fire control lines may be seeded with perennial grasses and legumes favored by a variety of wildlife species. Larger regeneration units may sometimes be created to address forest pest and health issues. Open well-traveled public access roads may be present.

Probable Management Practices:

- Construction and maintenance of trails for foot and bike travel.
- Creation and maintenance of long narrow wildlife openings, and permanent grass/forb openings.
- Planting of trees and shrubs to produce soft mast.
- Thinning of pine to restore hardwood, and timber salvaging activities.
- Release of hardwood regeneration using mechanical treatments, prescribed fire, or ground-applied herbicides.

- Prescribed burning activities, including fireline construction and seeding of plowed firelines in perennial grasses and forbs.
- Gating of roads to restrict access.

Embedded Prescriptions: None.

3.9: Black Bear Habitat Management

To sustain a viable black bear population, contiguous habitat of adequate size, quality, and location should be managed in a semi-primitive setting. In this Plan, habitat that provides the conditions described for black bear is designated as the black bear habitat management prescription. In addition to the areas designated, habitat also exists within the management prescriptions for Wilderness, RCW HMA, and the Wildland Urban Interface (where it overlaps with the previously listed management prescriptions). Despite the desirable black bear habitat conditions that exist in these areas, each will be managed under compatible, but separate management prescriptions.

Reference Condition: As a reference condition, the large block of unroaded pocosin wetlands and pond pine forest southeast of the town of Havelock, east of Highway 70, and south of State Highway 101 is used. The area consists primarily of pocosin wetlands and pond pine forest, with scattered mixed loblolly pine and longleaf pine, and some dominant longleaf pine forest types. It is characterized by dense shrub understory with scattered emergent trees, commonly pond pine. The vegetation is dominated by woody, predominantly evergreen shrub species. Soils are poorly to moderately poorly drained and highly organic. The dominant vegetation is usually broad-leaved evergreen shrubs or low trees, such as titi, red bay, sweet bay, sweet pepperbush, fetterbush, blueberry, huckleberry, bitter gallberry, and wax myrtle, overtopped by pond pine and dense matting of greenbrier vine. In addition to pond pine, loblolly pine and longleaf pine may be found in better-drained areas. Bald cypress, tupelo (*Nyssa* species), and red maple may be present on less organic soils.

Public recreational use is low and infrequent. The area is mostly unroaded. Some existing roads may be closed to public motorized vehicle use. Recreation settings are semiprimitive. Management activities in the area are restricted to those that enhance natural community features. Users will experience a sense of isolation and remoteness, similar to that experienced in designated wildernesses. ROS class acres are primarily roaded natural and semi-primitive non-motorized.

Variation from Reference Condition: Heavily traveled open public roads may cross key bear habitat. Whenever possible, roads will be closed to motorized vehicle use, and maintenance standards will be low. Selected roads and portions of roads may be opened during the fall hunting season to provide traditional hunter access.

Key bear habitat may receive moderate to high levels of management to reduce fuel accumulations in the WUI. High-use recreational trails may be developed, but they will be on the periphery of key bear habitat.

Probable Management Practices:

- Trail construction and maintenance for hiking, mountain biking, and horseback riding. Creation of parking areas at trailheads.
- Soft mast tree and shrub plantings, along with maintenance of grass/forb wildlife openings.
- Prescribed burning activities.
- Road reconstruction, and road obliteration.
- Gating of roads to restrict public motorized vehicle access.
- Mowing roadsides on closed roads.
- Military training operations.
- Plugging of drainage canals to restore natural water levels.
- Boat launching sites.

Embedded Prescriptions: About 5,337 acres of SIA (natural areas) and 150 acres of SIA (heritage resource areas) are embedded in black bear habitat management prescription.

3.10: Developed Area Management

Areas will be developed or maintained for recreation, interpretation, administration and communication, water impoundment, and special uses. Developed areas consist of small patches or corridors in a matrix of forested landscapes. The size of developed areas depends on function and capacity. Appropriate recreational settings are described in Appendix G.

The Developed Area Management prescription is further divided into five subheadings.

3.10.1: Recreation Sites in Rural Settings

Reference Condition: Cedar Point Campground is used as a reference condition for this landscape element. Large trees are distributed widely throughout a 10-acre area that forms an opening in an otherwise forested landscape. Campground access is by 2-lane gravel road, with a corridor of approximately 3/4 mile that is quite scenic. Paved roads weave throughout the area to provide access to campsites that are close to one another. Camping sites are available for tents or campers. People use the area to socialize and establish a base camp from which to fish, hunt, explore nature, and participate in other outdoor activities.

Several buildings designed to harmonize with the natural surroundings provide flush toilets and hot showers. Water spigots and refuse containers are distributed throughout the area. Electric hookups are provided to power appliances, such as air conditioners in campers during the summer. The campground capacity is 215 people.

A 1/2-acre grass clearing adjacent to the campground has tables for picnicking, providing capacity for up to 24 people. Near this site is the starting point for an interpretive hiking trail about 2 miles in length.

Variation from Reference Condition: Recreation sites across the CNF vary in capacity and support facilities. For example, some campgrounds may not have electric hookups, and some may have gravel rather than paved roads. Some campgrounds have vault toilets and/or no showers.

Probable Management Practices:

- Reconstruction and maintenance of existing support facilities and utilities.
- Removal of hazard trees that cause safety concerns.
- Site expansion involving construction of new support facilities.
- Construction of group camping facilities.

3.10.2: Recreation Sites in Roaded Natural & Semi-Primitive Motorized Settings

Reference Condition: Brice Creek boat ramp is used as a reference condition. Brice Creek dissects the relatively contiguous canopy of the riparian corridor. A 1/4-acre clearing at the Brice Creek landing creates a larger gap in the canopy. The landing has an accessible wooden platform at the water's edge for viewing, fishing, photography, and other similar activities. A ramp is provided for boat launching and boat landing. Clear blackwater and undisturbed stream banks create a distinctively scenic landscape. People meet here for family gatherings, to view scenery, or to launch a canoe expedition to explore the creek's unique resources.

The approach road is a single lane gravel road with turnouts. Along the road on national forest land, forests dominate the landscape, with occasional openings of young trees. Patches of blackened tree trunks can be seen as evidence of recent prescribed burns. Patches of highly scenic longleaf savanna are interspersed with loblolly pine plantations. Over time, as longleaf is restored, savannas will occur along the approach road.

Variation from Reference Condition: Other sites have varied sizes of clearings dependent on the size of groups to be accommodated. Some sites provide access that passes through natural settings to reach attractive, scenic sites. Different areas have rustic campsites, tent pads, and fire rings for overnight use. In the future, variation among sites will be evident, as facilities are developed to accommodate special recreation activities, such as rifle ranges. These sites will be designed to preserve scenery, even though scenery is not the primary purpose for the facility.

Probable Management Practices:

- Mowing and other maintenance of clearings and roads.
- Fuel treatments including prescribed burning and tree harvesting may occur adjacent to the site.
- Within sites, construction of support facilities and reconstruction of existing support facilities, will occur.

- History, prehistory and the natural community will be interpreted through signing and brochures at various sites.

3.10.3: Water-Based Recreation and Heritage Resource Interpretation

Many areas within roaded natural and semi-primitive settings have unique natural attractions that draw interest. Examples include water, and heritage resource management zones that have rich concentrations of pre-historic and historic sites. Within these unique areas, more emphasis will be placed on dispersed recreation, access points to the water, and interpretation. Access will be provided in a quarter-mile corridor off water bodies on national forest to satisfy the needs of humans to learn about their history, to satisfy a desire for access to the water, and to meet the obligation of the Forest Service to protect and interpret heritage resources.

Reference Condition: Pine Cliff/ Cahooque Creek area is used as a reference condition. The landscape is largely natural and supports a mixed pine/hardwood ecosystem. Natural processes primarily determine vegetation patterns. A great deal of variety exists in the vegetation. Small openings are located in the forest where vegetation has been modified to enhance recreation.

Access is provided primarily by roads, and recreation is centered around water — either lakes, streams, or rivers. The area has high recreational use resulting in a lower level of solitude. However, certain groups of users, such as hunters or bikers, may be restricted from specific areas. Non-motorized trails are present, particularly adjacent to water. Along these trails, facilities exist for the comfort and convenience of the user. Rustic camping occurs in dispersed camps near the water.

Interpretation of the natural and historic features is provided on site, at trailheads, and at other points of access into the area. Pine Cliff visitors can learn how prehistoric residents lived near the shell midden along the Neuse River, and they can learn about the importance of pine tar in our history from the remnants of a tar kiln. Some facilities may include historic buildings like the picnic shelter at Pine Cliff. Primitive, rustic, and developed boat ramps provide access to water.

Variation from Reference Condition: The hardwood cypress wetlands provide a different condition with limited access to the water for recreation, and development of facilities may be limited. Examples include Holston Creek and Hunter Creek, where few miles of road exist, and access is primarily by foot. At the few rustic facilities that exist, visitors may find semiprimitive motorized boat access sites, individual campsites, and heritage resource interpretation of past inhabitants and their activities.

Probable Management Practices:

- Construction and maintenance of trails, trailheads, boat launch areas, and interpretive kiosks and signs.
- Monitoring of existing camping areas and construction of new small, rustic facilities.
- Using prescribed fire as necessary to help restore and maintain the ecosystem.

- Limited tree removal to create a safe condition in developed sites.
- Testing of known archeological sites to increase our knowledge of the area and, at times, to permit other activities to occur on those sites.
- Offering ‘Passport In Time’ projects that invite the public to help with archeological projects when access and facilities permit.
- Reconstruction to preserve or restore historic features. These areas are classed as not suitable for timber.

Embedded Prescriptions: About 239 acres of SIA (natural areas) and 246 acres of SIA (heritage resource areas) are embedded in this subheading.

3.10.4: Impoundments

Reference Condition: Catfish Lake Impoundment is the only such structure on the CNF. It covers 820 acres inside a forested matrix. The previous owner farmed the area by constructing a series of interconnected ditches in large rectangular configurations. Headgates, risers, and ditches flood the area, creating ponds that are rest stops for waterfowl as they migrate along the Atlantic flyway. In the spring, the ditches allow water to drain, providing a rich seedbed for cereal grains, which are foods for deer, quail, bear, and other wildlife species.

The interconnected ditches form six sub-impoundments, allowing the water and farming operations to be conducted separately among them. Therefore, the flooding, liming, fertilizing, prescribed burning, and planting of crops can be rotated within the impoundment, resulting in capacity that is highly-sustainable for wildlife and waterfowl. The North Carolina Wildlife Resources Commission co-manages the impoundment with the Forest Service to provide wildlife viewing and waterfowl-hunting opportunities.

The impoundment is accessible off Catfish Lake Road, and is centrally located between populated areas of Highway 58 and 70. Hunters, wildlife viewing enthusiasts, mountain bikers, and hikers use the area. The impoundment draws visitors because of the rich abundance of wildlife in a concentrated area. At certain times of the year, visitors will encounter many other people.

Variations to the Reference Condition: The impoundment’s condition depends on investments in fertilizing, liming, crop planting, and managing the water levels. Without this high-management intensity, the impoundment would gradually revert to the pocosin-type vegetation that surrounds it.

Probable Management Practices:

- Crop planting.
- Fertilizing, liming, flooding and draining of water.
- Roller chopping and disking.
- Prescribed burning.
- Construction of accessible boardwalks, viewing platforms and trails that facilitate wildlife viewing and hunting.

3.10.5: Administrative & Communication Sites and Special Uses

Reference Condition: One reference condition will not describe the variety of administrative facilities, communication sites, and special uses.

Variation from Reference Condition: Administrative sites include the support facilities for offices and work centers. Communication sites include the towers for sending, receiving, or relaying communication signals. Special uses included in this subheading are those that affect land use. Utility corridors are examples. Each of these sites creates a gap in the forest. The vegetative cover is usually maintained as grass/forb. The function of most special use sites is to transmit energy or raw materials across the forest to population centers. While these sites go through areas with other desired conditions, the stipulations in the permit take precedence. In the future, in an effort to minimize the effect of these sites on other resource values, new sites will preferably be located along existing corridors, such as roads. These new uses should not create additional impact to resources.

Probable Management Practices:

- Issuing permits for electronic site use and utility corridors.
- Maintaining corridors, communication sites and administrative facilities will include mowing, bush hogging, clearing, and herbicide use.

Embedded Prescriptions: About 25 acres of SIA (natural areas) and 62 acres of SIA (heritage resource areas) are embedded in developed areas.

3.11: OHV System Management

Off-highway vehicle (OHV) use is popular on national forests. Vehicles include motorcycles, 4-wheelers, and full sized 4-wheel drive vehicles. Riders prefer to test their skill in a variety of settings. They want diverse challenges and, at times, remote experiences. Historically, on the Croatan National Forest, OHVs have used system roads, designated OHV routes, and unauthorized roads or trails. Many of the unauthorized trails are in areas with sensitive plant and animal species, and some are on dead-end routes favorable for illegal trash dumping and dangerous, unregulated shooting.

To meet demands for OHV use in ways that protect other resource values, a trail system will be designed in an area that has already been used by OHVs, east of Black Swamp Road. The trail system will provide continued access for other forest users, especially hunters and fire protection, while also providing a desirable OHV experience. A user fee system will be established to assist with maintenance of the trail system. Ideally, a user group will form and assist with the required maintenance and will help educate other users.

Reference Condition: The ideal condition for an OHV trail system consists of challenging trails that are maintained to a level that prevents resource damage. This combination is difficult to attain since a challenging and enjoyable ride often requires

environmental attributes that may be considered as less than ideal for preventing resource damage. The trail system will consist of loop travel ways, with a designated parking area, specific ingress and egress points, and a user fee station at which to collect dollars to be used in support of the trail system. Roads will be passable to street vehicles or four-wheel drives, although roads may be seasonally closed to maintain the condition. Access for hunting will continue to be provided, considering the extensive historical use in this area. Visitors in search of a serene experience will wisely not choose this area in which to recreate.

The Black Swamp area has been selected as the area in which to concentrate OHV use, and in which to work with user groups such as OHV-riders and hunters, to monitor and evaluate the area for opportunities. Since this area is already used by OHVs, opportunities will be explored to enhance or improve existing routes, re-designate routes, expand routes, close routes, or a combination of these actions.

Variation from Reference Condition: Currently the Black Swamp Road OHV area consists of approximately 8 miles of loop trail. Other trails within the Black Swamp Area, adding approximately 2 miles, are short but help disperse travelers and hunters.

Probable Management Practices:

- Trail design and reconstruction with mechanized equipment, signing to clarify the routes, gating to control access, construction of a parking area, and user fee station.
- Prescribed burning may also occur in this area.

Embedded Prescriptions:

3.12: Special Interest Areas Management

A Special Interest Area is a Forest Service designation that acknowledges areas with special characteristics, such as scenic, historical, geological, botanical, zoological, or paleontological. This designation provides protection of the area through special consideration during management planning. Two categories of Special Interest Areas are recognized in the Plan – natural areas and heritage resource areas. Natural areas have special aquatic, biotic, or geologic value, and are managed for the perpetuation of natural processes, natural communities and rare species. Heritage resource areas house the tangible remains of past use of the CNF. These areas are protected because of the unique characteristics and significance they provide.

3.12.1: Natural Areas Management

Seventeen natural areas on the CNF occupy approximately 50,000 acres. They support over half of all occurrences of threatened, endangered, sensitive, and locally rare species on the CNF. Individual natural areas vary widely from the reference condition described

because natural areas represent the full range of plant communities and ecological types found on the CNF. There are examples of pocosin, cypress-hardwood swamps, pine savannas, mesic hardwood slopes, maritime forests, marshes, pond pine forests, and mesic pine flatwoods. A common characteristic of these areas is a low level of human influence.

Reference Condition: Patsy Pond Registered Natural Heritage Area is used as the reference condition. The topographic structure is an old beach ridge system nearly 10,000 years old and part of a barrier to the ancient Neuse River channel. Over time, wind and water have reshaped old surfaces into scattered depression ponds, extensive low ridges, flats, and sinkholes. Beneath the soil surface in the bluish-gray claylike sand, the fossil remains of aquatic molluscan and ostracod fauna are testament to the past. The ponds, products of natural impoundments of the old stream network, have different hydrologic regimes. The result is a wide diversity of intergrading communities, with their unique plants and animals.

Pond vegetation is divided into zones created by variations in underlying substrate. Free-floating plants and well-rooted tall marsh grasses dominate permanently flooded areas. Rare species such as dwarf bladderwort and loose water milfoil occur in this zone. Along seasonally flooded pond edges, marsh grasses, mixed herbs, and tall grasses are dominant. Rare species that occur in this zone include Robbins' spike rush and flax leaf seed box. On the fringe of the pond depression, layers of dwarfed shrubs form the transition zone between the pond and upland communities. Included, along with the common titi, myrtle-leaved holly, and fetterbush, is pond spice—a rare species.

The myriad of plant communities associated with these ponds provides habitats for a wide variety of insects and amphibians. Overall, diversity of the site is therefore enhanced by the variety, proximity, and seasonality of these wetland systems. In contrast, the sandy ridges, slopes, and flats of adjacent uplands support a fairly simple system of open forest dominated by longleaf pine and turkey oak.

Porous sands underlying ridges drain most water and nutrients away from plant roots. Trees are stunted and widely spaced. Forest stands in these areas represent the most xeric longleaf pine savannas found on the CNF.

Trails near the ponds and roads provide easy foot access to the natural area. Occasional interpretive signs explain special geological and botanical features in the area. Visitors experience a fairly primitive setting and except for occasional roads, they feel some solitude from the sights and sounds of others.

Variation from Reference Condition: In some areas, improved roads and trails provide access routes for site maintenance, nature interpretation, environmental education, and scientific research. Natural processes may be simulated by management practices such as prescribed burning and thinning where restoration to more natural conditions is warranted.

Probable Management Practices:

- Prescribed burning.
- Trail construction.
- Interpretive signing.
- Thinning to restore natural community structure where needed.

Description of Designated Areas

The following are brief descriptions of natural areas designated as Special Interest Areas on the CNF. These SIAs are also either currently or will be registered with the NCNHP as Natural Heritage Areas.

CEDAR POINT/WHITE OAK RIVER MARSHES SIA consists of a series of natural communities representative of coastal estuarine systems. The SIA is approximately 241 acres in size and is located in the southwestern portion of the CNF. It is currently registered with the North Carolina Natural Heritage Program (NCNHP). Salt to Brackish Marsh occurs as well as upland forests dominated by a mixture of hardwoods and pines that contain remnants of maritime forest. The marshes of Cedar Point provide important breeding and feeding habitat for birds, fish, invertebrates, and mammals.

FLANNERS BEACH SIA is located on a landform of relict sand dunes up to 30 feet in elevation, with marl limestone sediments between the ridges. High riverbanks and bluffs are located along the southern shore of the Neuse River. The SIA is about 180 acres in size and is located in the eastern portion of the CNF. It is currently registered with the NCNHP. The site provides an important source of fossils from the tertiary and quaternary periods and contains mesic mixed hardwood forests, a brackish marsh, swamp forests, and a sandy beach along the Neuse River. Of most significance are the hardwood forests, which are dominated by oaks, hickories, and loblolly pine. American beech dominates some slopes with common dogwood, yellow poplar, red maple, American holly, sourwood, and umbrella tree. In the understory, galax is common on upper slopes and broad beech fern and New York fern is common on the lower slopes.

GUM SWAMP BOTTOMLAND HARDWOOD FOREST SIA represents nonriverine wet hardwood forests (Shafale and Weakley 1990). Sites supporting this community, once very common, were extensively cleared for agriculture and are now very rare. The SIA is approximately 35 acres in size and is located in the east-central portion of the CNF and is currently registered with the NCNHP. Swamp chestnut oak dominates the canopy or is mixed with water oak, laurel oak, sweet gum, and yellow poplar. Species diversity in the herb layer is low, although ferns are fairly common and include lady fern, cinnamon fern, royal fern, netted chain fern, Virginia chain fern, and New York fern. Red shouldered hawks, black-throated green and black-and-white warblers, and bears use the area.

HADNOT CREEK PONDS AND LONGLEAF PINE WOODS SIA consists of floodplains and slopes along Hadnot Creek. It is approximately 410 acres in size and is located in the southwestern portion of the CNF and is currently registered with the NCNHP. Tidal marshes occur in the lower privately owned portion of the creek, also a

NCNHP SIA. The upper portions on Forest Service land include examples of Mesic Pine Flatwoods and occurrences of Bachman's sparrow, red-cockaded woodpecker, Carolina gopher frog, American alligator, and Hooker's milkwort. The more mature longleaf pine stands are within the old growth management prescription for upland longleaf pine.

HIBBS ROAD PINE RIDGES SIA is a series of low, narrow sand ridges, and mucky swales supporting a mosaic of wet longleaf pine savannas, pocosin, and pond pine woodland. It is about 1,500 acres in size and occurs in the southern portion of the CNF and is currently registered with the NCNHP. Longleaf pine dominates the forest canopy on the sand ridges, and many of these stands are within the old growth management prescription for upland longleaf pine. The shrub layer consists of inkberry, gallberry, and Carolina sheep laurel. The herb layer is dominated by wiregrass and creeping blueberry. Pond pine dominates the canopy in the swales. Fetterbush, gallberry, and titi form a dense layer of shrubs. The extensive ecotone between the two communities is especially diverse. Rare species include branched gerardia, roughed-leaved loosestrife, red-cockaded woodpecker, Bachman's sparrow, Venus flytrap, stalked milkweed, Carolina goldenrod, and Carolina asphodel.

HOLSTON CREEK FORESTS SIA represents the wet pine flatwoods community adjacent Holston Creek. It is approximately 50 acres in size and is located in the western portion of the CNF and is currently registered with the NCNHP. The flatwoods occur as several patches interspersed with pine plantations. The canopy is dominated by longleaf pine and loblolly pine. The understory includes loblolly pine, southern red oak, blackjack oak, water oak, post oak, and sweetgum. The shrub layer is dominated by inkberry and sweetgum. The herb layer is a diverse mixture of wiregrass, common broom sedge, numerous peas, and composites. Rare species include spring-flowering goldenrod.

HUNTER'S CREEK SIA comprises upland hardwood forests associated with the ravines and surrounding upland watershed of a tributary to Hunter's Creek. It is approximately 40 acres in size and is located in the western portion of the CNF and is currently registered with the NCNHP. Two hardwood communities occur in the SIA—dry-mesic oak-hickory forest and mesic-mixed-hardwood forest. The oak-hickory community is dominated by white oak but contains mockernut hickory, pignut hickory, loblolly pine, and yellow poplar. The subcanopy is composed of dogwood and sourwood. The shrub and herb layers are sparse and include sparkleberry, lowbush blueberry, horse sugar, elephant's-foot, arrow leaf ginger, partridgeberry, and Christmas fern. On the steeper slopes and narrow floodplain, a more diverse forest is found. This mesic mixed hardwood forest includes additional tree species such as American beech, Shumard oak, sweet gum, green ash, ironwood, and southern sugar maple. The herb layer is more diverse with species such as chain fern, turpentine root, southern lady fern, Christmas fern, wild yam, jack-in-the-pulpit, elephant's foot, sanicle, may apple, New York fern, and green adder's mouth.

ISLAND CREEK SIA occurs along a blackwater tributary to the Trent River. It is approximately 133 acres in size and is located in the northern portion of the CNF and is currently registered with the NCNHP. Island Creek has down-cut through marl limestone and formed a narrow valley with numerous rock outcrops that support rare ferns. Its

highly acid waters, originating in the Croatan central pocosin, are neutralized as they flow over the exposed marl. The upland forests are diverse and composed of species more typical of the piedmont and mountains. Canopy tree dominants include American beech, bitternut hickory, southern sugar maple, yellow poplar, swamp chestnut oak, shumard oak, white oak, and black walnut. Because the topography is dissected, these species grow adjacent to bald cypress and swamp tupelo associated with the stream channel. The subcanopy is composed of large witch-hazel, flowering dogwood, hop hornbeam, ironwood, sourwood, red mulberry, umbrella magnolia, and American holly. Rare species include Carolina spleenwort, Tennessee bladder fern, Florida adder's mouth, Hall's pocket moss, shadow-witch, and Godfrey's sandwort.

CROATAN POCOSINS includes Catfish Lake/Catfish Lake South Wilderness, Great Lake/Pond Pine Wilderness, Little Lake, Long Lake, Sheep Ridge Wilderness and Pocosin Wilderness. The SIA is approximately 40,000 acres in size and dominates the central portion of the CNF. It is currently registered with the NCNHP. The Croatan pocosins are among the best quality and largest examples of undisturbed pocosin community types in the region. The low pocosin community type is considered to be the best developed and oldest in North Carolina (Otte 1981). This type has not undergone any major changes to vegetation type in the last several thousands of years. Other communities include high pocosin and pond pine woodlands. The peatlands began as blocked drainage systems 10,000-12,000 years ago. The thickest peat deposits from 6-10 feet deep are found in the old channels of the blocked stream system. The pocosins are dominated by pond pine and evergreen, semi-evergreen, and deciduous shrubs. Shrubs can be very dense and include fetterbush, bitter gallberry, titi, zenobia, loblolly bay, and red bay. Lamb-kill, leather-leaf, red chokeberry, and blueberries are common. At least 25 other species of less common plants occur occasionally on favorable sites. Among these are insectivorous species such as pitcher plants and sundews. Rare species include Venus flytrap, American alligator, Fitzgerald's peat moss, lined bulrush, and spoon flower.

LITTLE ROAD LONGLEAF PINE SAVANNAS SIA represents the pine ridges and open savanna landscape between the CNF's central pocosin and the dissected uplands to the east. It is approximately 400 acres in size and located on the northeastern portion of the CNF and is currently registered with the NCNHP. The majority of the area consists of longleaf pine mesic to wet savannas with an open and mostly mature canopy. The understory is dominated by herbs and low shrubs including wiregrass, bracken fern, cane, inkberry, and blueberry. Most longleaf pine stands are within the old growth management prescription for upland longleaf pine. These woodlands occur on low, poorly defined sand ridges that are only one to several feet higher than the surrounding landscape. These ridges form a line running northwest to southeast, about 7 miles in length. In combination, they support one of the most concentrated populations of RCW on the Croatan.

The second major community type is similar to a coastal prairie and occurs along an adjacent powerline right-of-way. These man-made habitats, kept free by periodic mowing, support numerous herbaceous species including at least eight species of orchids.

Rare species within the SIA include scale-leaf gerardia, branched gerardia, Venus flytrap, red-cockaded woodpecker, yellow fringeless orchid, feather-bristle beakrush, and Elliott's yellow-eyed grass.

MILLIS ROAD SAVANNAS AND POCOSINS SIA is part of the "Newport Barrier" relict beach ridge system formed during the last major regression of sea-level in the late Pleistocene (Mixon and Pilkey 1976). It is approximately 450 acres in size and is located in the southern portion of the CNF and is currently registered with the NCNHP. This area of low sand ridges and shallow swales supports the best quality example of longleaf pine savanna on the Croatan and one of the best in the coastal region of the state (Fussell and Wilson 1980). It is bordered on the south by a large tract of low pocosin creating significant ecotones between these two communities. The low sand ridges are dominated by longleaf pine savannas representing a variety of wet and mesic communities. The longleaf pine canopy is sparse and the forest is multi-aged. All of these stands are within the old growth management prescription for upland longleaf pine.

Wiregrass dominates the understory and other herbaceous species vary in a continuum from the ridge tops to the slopes. They include broomstraw, beak rush, blazing star, thoroughwort, and asters. Other common species include deer's tongue, vanilla plant, goldenrod, and carphophorus. Rare species include red-cockaded woodpecker, yellow fringeless orchid, Carolina asphodel, branched gerardia, Bachman's sparrow, stalked milkweed, argos skipper, berry's skipper, and two-spotted skipper.

MILLIS SWAMP ROAD PINEWOODS SIA occurs on low sandy ridges on the periphery of the CNF's central pocosin. It is approximately 250 acres in size and is located in the southern portion of the CNF. The site contains a large contiguous area of mature wet pine flatwoods (Schafale and Weakley 1990). These wet longleaf pine savannas are within the old growth management prescription for upland longleaf pine. The canopy is fairly open and the ground cover is dominated by wiregrass. Other common species include inkberry, bracken fern, and cane. A large number of species occur along the ecotone between the pine savanna and the adjacent pond pine woodlands. Rare species include red-cockaded woodpecker, Carolina goldenrod, branched gerardia, small butterwort, and Bachman's sparrow.

NINE FOOT ROAD/BROAD CREEK PINEWOODS SIA occurs in an area with distinct topographic relief on extensive sand ridges and peat-mantled swales. It is about 460 acres in size and located in the southern portion of the CNF. The relict beach dunes are dominated by excellent examples of wet pine flatwoods on the lower parts of the ridge and good examples of Xeric Sandhill Scrub (Schafale and Weakley 1990) on the upper ridges. The mosaic of xeric, mesic, and wet longleaf pine savannas along with the intervening wet pond pine swales support a high diversity of species. All the groves of flat-topped longleaf pine and young trees regenerating in gaps are within the old growth management prescription for upland longleaf pine. The understory is dominated by blue huckleberry, dwarf huckleberry, and inkberry in the shrub layer and wiregrass, creeping blueberry and bracken fern in the herb layer. Rare species are branched gerardia, Bachman's sparrow, stalked milkweed, Venus flytrap, southern bogbutton, red-cockaded

woodpecker, small butterwort, yellow fringeless orchid, short bristled beakrush, Carolina goldenrod, Carolina asphodel, and savanna yellow-eyed grass.

NINE FOOT ROAD/ROBERTS ROAD LIMESINK PONDS SIA includes an extensive longleaf pine flatwood and savanna on a fairly flat relict dune ridge. The southern section represents a series of low, narrow sand ridges and mucky swales supporting a mosaic of wet longleaf pine savannas, pocosin, and pond pine woodland, formerly included in the Hibbs Road Pine Ridges SIA. The SIA is approximately 1,020 acres in size and is located in the southern portion of the CNF. The primary feature of the area is the limesink ponds and their associated vegetation. Most of the ponds have a dense rim of titi and highbush blueberries, pond spice, and greenbrier. The ponds support a variety of species unique to their particular hydrology. The majority of the SIA supports a Wet Pine Flatwood community, dominated by a fairly dense canopy of longleaf pine with a sparse understory of sweetbay and turkey oak. The older longleaf pine stands are within the old growth management prescription for upland longleaf pine. Low shrubs such as inkberry, wax myrtle, and dwarf huckleberry occur in patches. Rare species include stalked milkweed, pond spice, red-cockaded woodpecker, West Indies meadowbeauty, and savanna yellow-eyed grass.

PATSY POND LIMESINK COMPLEX SIA contains a series of naturally impounded ponds that occur on an old beach ridge system and the adjacent xeric and dry longleaf pine communities. The SIA is approximately 500 acres in size and is located in the southern portion of the CNF and is currently registered with the NCNHP. The ponds support a large variety of species many of which are unique to the specific hydrologic regime of the site. The sandy ridges, slopes, and flats support an open forest community dominated by longleaf pine and turkey oak. These areas form the largest forest patch within the old growth management prescription for upland longleaf pine.

Huckleberries and blueberries dominate the shrub layer and wiregrass dominates the herb layer. This SIA has some of the highest concentrations of rare species found on the Croatan. They include red-cockaded woodpecker, branched gerardia, Bachman's sparrow, stalked milkweed, Venus fly trap, Robbins's spike rush, pond spice, flax leaf seed box, leafless water milfoil, southeastern panic grass, Carolina gopher frog, West Indies meadowbeauty, Harper's beakrush, long-beak bald-sedge, and Carolina goldenrod. (For more details see description of the reference condition for Section 3.12.1.)

PETTIFORD CREEK OPEN FLATWOODS SIA occupies upland flats and gently rolling loamy soil ridges that are dissected by small tributaries of Pettiford Creek. It is about 300 acres in size and occurs in the southwestern portion of the CNF. The ridges are separated by pocosin and swamp and are vegetated primarily with mesic pine flatwoods, with significant amounts of pine savanna along the lower edges. Small areas of wet pine flatwoods and pine/scrub oak sandhill communities are also present. The older longleaf pine stands are within the old growth management prescription for upland longleaf pine. Rare species include scale-leaf gerardia, Bachman's sparrow, Venus flytrap, red-cockaded woodpecker, Carolina gopher frog, feather-bristle beakrush, Georgia nutrush, Carolina goldenrod, and giant spiral orchid.

PRINGLE ROAD BAY RIMS SIA is a large peatland area with numerous sand ridges. Some of the patterns clearly indicate Carolina bays buried by the peat, with emergent sand rims; other ridges are irregular in shape. The SIA is approximately 1,700 acres in size and is located in the southern portion of the CNF. Sand ridges are dominated by Wet Pine flatwoods and xeric sandhill scrub communities. The canopy consists of patchy longleaf pine and pond pine. Ridges that have an old growth canopy are within the old growth management prescription for upland longleaf pine. The herb layer is dominated by wiregrass, creeping blueberry; bracken fern, Maryland meadow-beauty, savanna meadow-beauty, and Carolina yellow-eyed grass are common herbs. Swales are dominated by pocosin and pond pine woodlands. The pond pine woodland is one of the few examples on the Croatan that has been repeatedly burned. Large parts of this area form a diverse transitional ecotone with the longleaf pine communities. Rare species include Bachman's sparrow, stalked milkweed, Venus flytrap, pond spice, rough-leaved loosestrife, small butterwort, mimic glass lizard, red-cockaded woodpecker, feather-bristle beakrush, Chapman's arrowhead, Carolina goldenrod, and Carolina asphodel.

3.12.2: Heritage Resources Management

The CNF area has been occupied for at least 10,000 years. Heritage resources are the tangible remains of past use. Archeological sites are the physical remains of this occupation. Eleven Heritage Resource Management (HRM) Zones have been designated across the CNF because of their unique characteristics and significance.

Reference Condition: The Pine Cliff HRM Zone consists of a prehistoric shell midden, a historic tar kiln, and a picnic shelter built by the Civilian Conservation Corps (CCC). The shell midden is a refuse accumulation left during the Woodland period by prehistoric occupants of the Neuse River bluff about 2,000 years ago. Oyster and clamshells, ceramic shards, and food bones are found in the midden, which reflects seasonal use of aquatic resources.

The historic tar kiln is discussed in the National Forests in North Carolina Forest Interpretive Plan. It is a circular earthen and charcoal mound with a raised perimeter and sunken center, which gives it a "doughnut" shape. This is the archeological result of firing soil-covered lightwood from longleaf pine to produce tar for waterproofing sailing ship hulls and rigging. Tar kilns are an integral aspect of the naval stores industry and a source of the present day nickname of "tarheels" for North Carolina residents.

The CCC picnic shelter was constructed between 1936 and 1942 by young men who lived in the camps on the present-day CNF. The CCC was one of President Franklin Roosevelt's New Deal programs to provide employment during the Great Depression. This shelter and the Newport Fire Tower are the last two CCC era structures remaining on the CNF.

In the future, and where feasible, historic structures and prehistoric sites will be interpreted for the visiting public. Trails or roads will lead to the sites. Visitors will

encounter many other visitors recreating in the area. Other recreational activities that may occur nearby are camping and picnicking.

Variation from Reference Condition: The shell midden was found eroding from the Neuse River bluff during the Hurricane Fran damage assessment. Now partially uncovered, it is subject to wind and water erosion and illegal artifact collecting. The tar kiln is physically stable due to a pine overstory and shrub understory. However, road maintenance activities may have damaged its integrity. The CCC shelter is standing and frequently used for recreation by visitors. Due to its age, many structural components will need to be replaced. If left unmaintained, the structure may become unsafe for public use.

Probable Management Practices:

- Salvage and stabilize eroding shell midden.
- Determine prehistoric and historic site extent.
- Interpret tar kiln as an example of naval stores industry.
- Record, research, stabilize, and interpret the CCC picnic shelter.

Description of Designated Areas

The following are brief descriptions of heritage resource zones designated as Special Interest Areas on the CNF. These zones contain one or more significant archeological sites. The sites may be prehistoric, historic, or encompass both cultural components. Some zones are completely inventoried, while others are partially inventoried. Some sites were evaluated for significance, and others have not been evaluated.

THE ISLAND CREEK SIA, located north of Island Creek Road (SR1004), is in the northern part of the CNF. The area is 35 percent surveyed and contains at least eight prehistoric and historic archeological sites—six Class II and two Class III. The area has sites from early historic settlement, the naval stores industry, and the prehistoric era. The area needs to be inventoried and test excavated. Archeological sites near the existing trail can be interpreted, and more interpretive trails may be designed.

THE BRICE CREEK SIA lies west of Brice Creek, south of Georges Branch, north of Black Branch, and east of FR170. The area includes a cemetery, homesite, and buffer south of FR121A. This parcel is 75 percent surveyed and contains 17 known Class II sites. Inventory, testing, and scientific research should be conducted at several sites. Low impact trails, such as canoe trails should be emphasized. Interpretive opportunities exist along the waterways, which were used by prehistoric and historic inhabitants. Civil War interpretation is possible through cooperation with the New Bern Historical Society.

THE WHITE OAK RIVER SIA, including Holston and Hunter Creek tributaries, is a corridor extending a quarter of a mile on either side of these drainages. The SIA is 20 percent surveyed. A total of 59 prehistoric and historic sites need to be salvaged and stabilized. Research should be conducted at the large historic cemetery on the parcel. An opportunity exists to investigate a postbellum agricultural complex. Sites need interpretation with buffer zones included.

THE HOLLAND POINT SIA is located in the southwest corner of the CNF. White Oak River and Pettiford Creek and Bay border this SIA's west side. The site extends 300 feet inland. This large Class II prehistoric site needs to be stabilized to prevent ongoing storm erosion. Extensive tests need to be conducted for scientific research and interpretation. All special uses should be closely coordinated to ensure that development and uses will enhance the site, rather than negatively impact it.

THE FORT CANNADY SIA, is located in the south central portion of the CNF and includes a Civil War northern fort. The area is south of Roberts Road (SR1140) and east of Nine Foot Road (SR1124). The SIA extends 1,000 feet south of Roberts Road and about 1,500 feet east from Nine Foot Road to private land boundary. This 100-percent-surveyed SIA contains one Class II historic site. The site should be monitored on a regular basis to deter looting. In addition, the site needs interpretation and a signed trail.

THE OYSTER POINT SIA, in the southeastern part of the CNF, is a large prehistoric site bordering the Newport River. The area's buffer extends 300 feet inland and is 35 percent surveyed. Because of erosion caused by recreation and natural processes, the site needs stabilization. Phase II investigations should also be conducted. In planning development, this site's preservation should be considered.

THE PINE CLIFF SIA is located just east of Marine Corps Air Station Cherry Point along the Neuse River. The north side is bordered by the Neuse River, and the east and west sides are bordered by private land. The area extends 1,000 feet deep, with a maximum width of 1,500 feet. The area, which is 20 percent surveyed, includes a Civilian Conservation Corps picnic shelter and an eroding prehistoric shell midden. The shelter needs recording, research, renovation, and interpretation. The eroding shell midden needs salvaging and stabilization. The extent of prehistoric and historic components needs to be determined. The tar kiln along the west side of Pine Cliff's entrance road (FR132) should be interpreted to show the history of the naval stores industry.

THE CAHOOQUE CREEK AND HANCOCK CREEK SIA, located west of the Pine Cliff SIA, consists of a 1,500-foot strip that runs along the east bank of Hancock and Cahooque Creeks and extends to Still Gut. Only 10 percent surveyed, this area has five known prehistoric and historic sites, which are all Class II. More inventories, assessments, salvage, and stabilization are needed. Potential exists for an historic-prehistoric interpretive trail to be constructed.

THE CAMP PATTERSON SIA, located in the Havelock vicinity, is bordered by U.S. 70 on the west side, Sandy Run on the east side, and a telephone tower on the north side. The area is 75 percent surveyed, with one Class II historic site. The camp complex needs to be test excavated and should not be exchanged. The area is suited for interpretation, because it is near a major Federal highway.

THE HICKMAN HILL TAR KILN COMPLEX is located in the east central portion of the CNF. This concentration of tar kilns lies west of U.S. 70. Each of the two tar kiln cluster contains four kilns. The area is 75 percent surveyed and has two Class II historic sites. Prescribed burning should be conducted with minimal damage to the site, which needs to be preserved and interpreted with a trail.

THE FISHER'S LANDING SIA is in the northeastern part of the CNF. The area extends 1,000 feet back from the Neuse River and is bordered on the north and south by private land. The area is 25 percent surveyed, with one Class II prehistoric-historic site complex that contains a ceramic prehistoric component, Civil War earthwork remnants, and Civilian Conservation Corps and Boy Scout camps. The complex should be stabilized to prevent ongoing erosion and deflation by Neuse River flooding. The area is perfect for interpretation, because of its location and physical remains. Prescribed burning in this area should be closely monitored.

3.13: Old Growth Forest Management

'Old Growth' can be described as ancient, primeval, pristine, decadent, over-mature, or senescent. The term "old growth" is used to describe relatively undisturbed, old forests. The dominant trees, best adapted to the site, have grown beyond the average life expectancy for the species, and stands have a significant number of trees that have large diameters for the site and flattened crowns; standing dead or downed trees are present, and in many stages of decay.

For many reasons, different forest community types attain different old-growth structure and composition. All tree species do not develop and age at the same rates, and sites and disturbance influence stand conditions to varying degrees. Cypress-tupelo swamps and upland hardwood forests are dominated by long-lived species and are influenced primarily by small-scale disturbances that kill single trees or groups of trees. Old-growth forests in these community types will generally have very large trees, often at low density in the canopy, mixed with younger trees in canopy gaps. The longer the forest develops under these conditions, the more multi-aged the structure becomes. Multi-aged forests may also develop on xeric-pine savannas or maritime sites dominated by trees with long intervals between seed crops. Stand structure is often uneven-aged because regeneration is sporadic after disturbances. Periodic stand replacement fires interrupt this "gap phase" development.

Longleaf pine savannas on mesic sites and other sites dominated by trees with short intervals between good seed crops often develop an even-aged structure or have larger age-cohort groups, because regeneration is rapid after disturbance. Even-aged forests are also likely to develop in communities dominated by short-lived species. Pond pine, for example, reproduces quickly after intense and widespread disturbances such as crown fire, but has a short life span. Pond pine may attain a large size, but old-growth forest structure is simplified. Stands may never develop multiple-age classes, and standing dead or downed trees may not be significant forest components.

On the CNF, even-aged and uneven-aged stands and gradations between the two occur. Variable old-growth conditions and structure are the result. Hurricanes, fires, and insect and disease outbreaks greatly influence the landscape positions where old-growth conditions can be attained, and they alter the structure of old-growth stands.

Reference Condition: The cypress-tupelo forests along Holston Creek and the White Oak River are used as reference conditions for old growth. The topographic structures are complex and include river courses, back swamps, swales, and a featureless floodplain. These function as channels for water, sediments, and nutrients carried into and out of the system. The water has a low sediment load, is colored dark by tannins, but is relatively clear.

The forest canopy is dominated by very large cypress and swamp tupelos rooted in the sands of the underlying ancient ocean shoreline. Since sea level is within 15 feet, the forest is seasonally flooded. The often deep flooding impedes invasion by more shade-tolerant species and maintains the relatively low diversity of species in the canopy.

Water flows are highly variable in small swales because these areas are flooded for long periods. There is low diversity in understory vegetation but the habitat is important for organisms generally associated with river channels. Where sediment accumulates or the frequency of flooding diminishes, the canopy species regenerate in gaps that have sufficient light reaching the ground surface.

Growth of trees is slow in the infertile, wet soil, and only very old trees attain large size. Still, cypress trees up to 5 feet in diameter are common, and these trees often have huge buttresses and networks of woody “knees” that provide structural support for a large and spreading crown. Trees often exceed 500 years in age. Individual trees support epiphytic plants, such as Spanish moss and parasitic plants like mistletoe. They also provide habitat for numerous animals such as the cottonmouth snake near the water and the osprey high in the branches.

Near tidal areas in the lower creek, redbay, Eastern red cedar, wax myrtle, titi, and cane may dominate patches in the understory or occur as scattered individuals. Away from tidal areas, American holly, ironwood, red maple, and dwarf palmetto may dominate the sparse understory. All these species provide habitat for insects and food for birds and small mammals. An ephemeral community of “draw down” herbs may occur on the huge buttresses of trees in some backwater areas where the canopy of small trees is especially sparse. Old age and natural treefall create woody structures that provide refuge for reptiles during floods, a platform for sunning, or a source of organic matter to be returned to the system.

There is very little sign of human activity except for “brushed out” areas along the stream course that allow for the passage of canoes. Visitors experience a natural setting with ecologically occurring changes. Developments along the river are rustic in design and blend into the landscape. Few other visitors will be encountered while boating or using the riverbank, except in developed sites.

Variation from Reference Condition: Most of the variation from reference condition is due not to management intensity but to site and species differences. Because little activity is planned in these areas, conditions within similar old growth forest types are due primarily to differences in their initial condition, and to the timing and intensity of natural disturbances, especially hurricanes.

Probable Management Practices:

- Prescribed burning in uplands.
- Research and monitoring.
- Occasional tree cutting to restore old growth structure, including gap creation, thinning, and providing large woody debris.
- Planting cypress in openings smaller than 1/10 acre to increase its future proportions in the canopy.
- Interpreting cultural resources in developed sites.

3.13.1: Descriptions of Old Growth Forests

COASTAL PLAIN UPLAND MESIC HARDWOODS: There is very little mention of upland oaks and hickories in the historical records of vegetation on the Croatan except in relation to slopes or fire-suppressed areas. There are less than 1,000 acres on the Croatan that fit these conditions and none of them currently meet the Region 8 criteria for old growth (USDA 1997).

These mixed evergreen-deciduous forests are multi-layered, containing overstory trees that exceed 100 feet in height, and understory species that are usually less than 30 feet in height. Major overstory species include American beech, yellow poplar, bitternut hickory, pignut hickory, white oak, swamp chestnut oak, black walnut, and loblolly or shortleaf pine. Southern sugar maple is common on less acidic soils. Understory trees may include hophornbeam, American holly, flowering dogwood, blue beech, umbrella magnolia, sourwood, and common pawpaw.

The ground cover may be very diverse with species typical of areas farther west and more mesophytic shrubs such as horse sugar, witch hazel, and blueberries or mesophytic herbs such as Christmas fern, southern lady fern, partridgeberry, slender spike grass, crane fly orchid, Indian cucumber-root, and beech drops.

The disturbance regimes include frequent, small-scale gaps of one or a few overstory trees and periodic (every decade) larger-scale disturbances in the form of hurricanes. Hurricanes may cause major damage in the overstory. Commonly gaps are captured by understory species, and so large portions of the canopy may contain no overstory trees several decades after a hurricane. Large amounts of coarse woody debris may be present after hurricanes, but this decays rapidly and does not persist much beyond 10 years.

There are opportunities for restoration and conservation of old growth coastal plain upland mesic hardwoods along all well developed slopes adjacent to stream courses. The best opportunities occur in the Island Creek SIA, and along Cahooque Creek and the

Neuse River. In addition, opportunities exist in the future for old growth in the upland hardwood management prescription.

CYPRESS-TUPELO SWAMP FORESTS: Although there are no large fluvial swamps on the Croatan, linear small stream swamps occur throughout the forest and support swamp and bottomland forests. Most cypress in these areas appears to have been logged before the end of the 19th century. There are few locations on the Croatan (Holston Creek, White Oak River) where primeval cypress remains. The closure of the water tupelo and swamp tupelo canopy after removal of the large, emergent cypress seems to have been a universal phenomenon throughout the south, and a century later there seems to have been little recovery of cypress (Frost 1996).

This forest community type is found almost exclusively in depressional areas that are prone to frequent flooding, such as swamps, deep sloughs, alluvial flats of major river floodplains, swamps of tidal estuaries, and isolated depressions. Approximately 7,900 acres on the Croatan fit these site conditions.

Principal tree species include bald cypress, water tupelo, and swamp tupelo. Pond cypress may be common at the heads of linear swamps. These species occur either singly or in mixtures. Green ash, swamp tupelo, and red maple are typical understory trees. Shrub species include titi, coastal sweet pepperbush, and fetterbush. The herb layer may be absent but can include lizard's tail, resurrection fern, and giant sedge.

The forest type is considered a stable climax although the dominant tree species are shade tolerant. The principal tree species have long life spans (300-1000+ years). Low intensity, small-scale disturbances are most common although large-scale disturbances from storm events, such as hurricanes or fire following years of drought occur periodically. These large-scale disturbance events are thought to trigger regeneration of the canopy dominants.

Opportunities for restoration and conservation of cypress-tupelo swamp forests exist throughout the hardwood cypress wetland management prescription. The best opportunities occur on the south shore of Great Lake, at Holston Creek and the White Oak River, along the upper Newport River, and within the National Forest ownership along Brice's Creek.

SOUTHERN WET PINE (i.e. POND PINE) FORESTS, WOODLANDS, AND SAVANNAS: The best and most extensive remaining examples of the tall forms of pond pine communities in the North Carolina coastal plain occur on the Croatan. Nearly 90 percent of the pond pine that occurs on these sites are in stands approaching an old growth condition.

This forest community type occurs on the outer parts of domed peatlands (pocosins) on poorly drained mineral soils that are mantled by organic matter. Sites supporting this type are extensive on the Croatan; approximately 32,000 acres fit these conditions. They are temporarily flooded or saturated but the water table drops to underlying mineral

sediment during the dry season. Unlike the adjacent deep organic peatlands, these areas may receive some influx of water with nutrients from adjacent uplands.

The forest canopy is open to nearly closed and dominated by pond pine that reach heights of 80 feet. Loblolly bay, sweetbay, red maple, and loblolly pine may be co-dominant in some areas. Except in areas recently burned, the shrub layer is tall and very dense often exceeding 20 feet in height. Common shrubs include titi, fetterbush, maleberry, gallberry, inkberry, blue huckleberry, coastal sweet pepperbush, and swamp red bay. Since fire is frequent, occurring as often as in the adjacent upland longleaf pine sites, giant cane dominates the shrub layer. Few herbs occur under the dense woody shrub and cane cover.

These communities are considered fire dependent. Both understory fires and crown fires are common. The former acts to open up the understory and create park like conditions more typical of longleaf pine communities. The latter functions as a regeneration mechanism for pond pine, which sprouts after burning and seeds prolifically from serotinous cones. The probability of crown fire is high since shrub growth is rapid and the shrub foliage highly flammable. Relative to the other major community types on the Croatan, old growth stand conditions with large scattered trees and dense canebrakes are therefore short-lived in the southern wet pine forests, woodlands, and savannas.

The best opportunities for restoration and conservation of old growth occurs within the black bear management prescription along Catfish Lake Road and on the fringes of the Masontown and Union Point pocosins. These opportunities also occur along the fringes of the large central pocosin within wilderness areas.

UPLAND LONGLEAF PINE: Naval store operations, the proliferation of logging railroads, steam log skidders, and steam sawmills during the 1800s and the more recent conversion of unmanaged woodlands to loblolly pine plantations accelerated the removal of longleaf pine, once a dominant tree species across the Croatan. Longleaf pine occupies less than 30 percent of its original range on the Croatan (Frost 1996) and only 5 percent of this is considered old growth.

The upland longleaf pine community group represents a large range in sites. Four major classes of longleaf in this group include: xeric-longleaf pine on excessively drained sands (LTP 1225), dry-mesic longleaf pine on well drained loamy soils (LTP 1124), mesic-longleaf pine on somewhat poorly to well drained mostly fine-loamy soils (LTPs 1022-1023), and wet-longleaf-pine savannas on poorly drained soils (LTPs 920-921). Stand conditions can range from flatwoods to savannas. There are approximately 27,000 acres on the Croatan that fit these site conditions.

The forest canopy in this community group is clearly dominated by longleaf pine. It is comprised of widely spaced trees with large diameters for the site that often exceed 200 years in age. The canopy is never closed but varies from 20 percent crown cover to over 50 percent crown cover. In the older trees, crowns are typically flat-topped, have rough

plated bark, and large branches. Midstory and understory trees occur only in canopy gaps and represent multiple cohort age groups.

On the most xeric sites, an occasional turkey oak that has survived the frequent understory fires may reach 15 feet in height, however, most occur as scattered small sprouts. Shrubs are uncommon or reduced in stature and never dominate the herb layer. Shrubs include inkberry, creeping blueberry, and wax myrtle. Wiregrass is dominant in the herb layer on all sites; however, herb diversity can be very high. On the most undisturbed areas, as many as 80 different species may be found. Some more common species include savanna muhly, little bluestem, beakruses, toothache grass, pale grass-pink, white colic-root, Florida yellow-flax, narrowleaf sunflower, sandbog death-camas and insectivorous plants, such as Venus fly trap, sundews, and pitcher plants.

An occasional snag or downed log occurs but these do not last long in this environment; they are either consumed by the frequent fire or are partially consumed and then decay rapidly. Growing season fire is the major disturbance regime and occurs every 2 to 4 years. This functions as a thinning agent and “fire-proofs” the overstory trees, by reducing both the amount and height of woody fuels.

The best opportunities for restoration and conservation of longleaf old growth occur within the RCW Habitat Management Area prescription, specifically within the designated Special Interest Areas (natural area). Limited additional opportunities, in the short term, occur within the other management prescriptions. Upland longleaf old growth is allocated within each management area (Appendix M). However, the greatest concentration of old growth longleaf pine is found within the RCW HMA in Management Area 4 (Management Areas are discussed in second section of Appendix A).

Chapter 4: Standards – Forest-wide and Management Prescriptions

All standards included in this chapter are to be applied appropriately to management of the Croatan National Forest. Standards are limitations on actions or thresholds not to be exceeded. These standards were developed to help attain the goals, objectives and desired conditions outlined in this plan, as well as to provide limits on how management might go about attaining them. Other limitations on management actions are contained in the RCW EIS, Vegetative Management in the Coastal Plain EIS as supplemented, and the SPB EIS, which are not duplicated here. Amendments to the federal or state statutes, such as the Clean Air Act or Clean Water Act also apply, as well as executive orders. Finally, management actions are limited by agency regulations and directives.

The standards are organized by program area. Program areas are divided into 2 groups: 1.) forestwide standards, which apply to all CNF lands; and 2.) those standards applied to specific management prescription areas. One standard may apply to multiple management prescriptions. This information is captured in the table for management prescriptions by listing the standard once in the right hand column and the applicable management prescriptions listed in the left hand column. A standard was included under a specific program area if that program area proposed the standard for management of a resource under its purview. For example, standards pertaining to old growth are included under the program area of Wildlife, Fisheries and Botanical, since old growth is a concern for species managed by this program area. When two standards refer to one activity, the more restrictive standard will apply.

4.1 Soil, Water and Air

4.1.0 Soil, Water and Air – <i>Forestwide standards</i>	
Soil	<p>4.1.0.1 Do not allow surface water management activities (e.g. ditching and draining) in organic soils or very poorly drained mineral soils if the activities would result in long-term changes to the natural hydrology. Catfish Lake Waterfowl Impoundment is excluded from this standard.</p> <p>4.1.0.2 On all sites/soils during normal moisture conditions:</p> <ul style="list-style-type: none"> • Use low ground pressure equipment when water table is 12 to 18 inches from the soil surface. • Construct the minimum number of haul roads and log decks needed for harvest operations, as consistent with the requirements for reasonable access from system roads and practical skidding distances to landings. • Locate roads and landings on the “best drained” sites within the area, to the extent practicable. • The Forest Service Timber Sale Administrator shall approve skid trail locations. • Use logging slash (limbs, tree tops, etc.), or other appropriate techniques, to distribute loads and to provide support for equipment when and where directed by Forest Service Timber Sale Administrator. <p>4.1.0.3 On poorly or very poorly drained soils, and on all sites/soils during wet periods:</p> <ul style="list-style-type: none"> • Use only low ground pressure equipment. • Do not operate equipment off the designated transportation system or designated trails when one or more of the following conditions exist: <ul style="list-style-type: none"> • “free water” can be squeezed from a handful of soil taken from within 8 inches of the surface • water table is within 12 inches of the surface • equipment can not be operated without excessive slippage, spinning, and/or soil displacement/disturbance due to loss of traction • routine equipment operation results in ruts that exceed 6 inches in depth except in localized, scattered areas or short segments (less than length of equipment used) • Do not operate mechanical equipment when the soil can be rolled to pencil size without breaking or crumbling (indicative of plastic soils with moisture content above plastic limit). • Use mats, corduroy, or other suitable methods to provide support for equipment on short segments of roads and trails as directed by the Forest Service Timber Sale Administrator.
Water	<p>4.1.0.4 New ground disturbing projects must be designed, implemented, and maintained to prevent visible sediment from entering perennial and intermittent stream channels in accordance with the same performance standards established for silviculture by the NC Forest Practice Guidelines Related to Water Quality (NC 1989). Existing sites, including dispersed and developed recreation, must be maintained to the same performance standards, through restoration and/or rehabilitation.</p> <p>4.1.0.5 Limit to the extent practicable the length of road ditch that outlets directly into natural stream channels.</p> <p>4.1.0.6 Design and implement all silvicultural activities to comply with the North Carolina Forest Practice Guidelines Related to Water Quality and, where applicable, the Best Management Practices for Forestry in the Wetlands of North Carolina (NC 1990). Note that these documents are commonly referred to as Forestry Best Management Practices.</p>
Air	See Forestwide standards for Fire.

4.1.1 Soil, Water and Air – <i>Prescription standards</i>	
<i>Management Prescription to which the standard applies.</i>	<i>Standard</i>
<ul style="list-style-type: none"> • River Corridors Eligible for Wild and Scenic River Status • RCW HMA • Black Bear Habitat • SIA (natural areas) • Wilderness 	4.1.1.1 Stop water flow in existing canals and ditches if it will restore natural hydrology. Retrofit with water control structures. Maintain ditches and canals where necessary for forest roads. Where canals and ditches occur in Wilderness, stop water flow outside of the Wilderness boundary in such a way as to restore natural hydrology within the Wilderness area.
<ul style="list-style-type: none"> • Wilderness • River Corridors Eligible for Wild and Scenic River Status 	4.1.1.2 Maintain portions of streams and rivers within the National Forest as flowing in a natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway.
<ul style="list-style-type: none"> • River Corridors Eligible for Wild and Scenic River Status 	4.1.1.3 Remove enough log or debris jams in the stream channels only to provide minimum passage by small boats in reaching the channel. 4.1.1.4 Do not outlet roadside ditches directly into stream channels.
<ul style="list-style-type: none"> • SIA (natural areas) • Pocosin Lakes 	4.1.1.5 Prohibit all direct and indirect alteration of natural hydrology.
<ul style="list-style-type: none"> • Hardwood Cypress Wetlands • Upland Hardwoods 	4.1.1.6 Use only herbicides labeled for use over water when within 150 feet of streams, rivers, lakes, ponds, and standing watered areas.

4.2 Wildlife, Fisheries and Botanical

4.2.0 Wildlife, Fisheries, Botanical – <i>Forestwide standards</i>	
Botanical	<p>Plant Communities:</p> <p>4.2.0.1 Use the terrestrial and aquatic ecological classification and the NC Natural Heritage Program site descriptions, as a guide to identify suitable sites for restoration of native plant communities.</p> <p>4.2.0.2 Allow no ground disturbing activities in marl outcrops or limesink ponds except where restoring natural community structure or function.</p> <p>4.2.0.3 Conserve and restore a network of small and medium-size areas of potential old growth for Upland Longleaf Pine communities.</p> <p>4.2.0.4 Retain at least 1/3 of ecologically suitable landtypes in old growth Southern Wet Pine Forests, Woodlands and Savannas (10,000 of the 30,000 acres), Cypress-Tupelo Swamp (2,300 acres of the 7,000 acres), and Upland Mesic Hardwood (300 acres of the 1,000 acres).</p> <p>4.2.0.5 Manage existing hardwood forest types as not suited for timber production, except those identified for restoration to longleaf pine.</p> <p>4.2.0.6 Do not harvest stands dominated by longleaf pine using even-aged or two-aged regeneration methods, except in natural catastrophe situations such as hurricanes, wildfire, insect or disease attack.</p> <p>Rare species:</p> <p>4.2.0.7 Prohibit the use of herbicides in powerline rights-of-way where rare plant species occur or may occur.</p> <p>4.2.0.8 Prepare biological evaluations for projects, including vegetation management, to determine effects on any species listed (or proposed for listing) as threatened or endangered by the USDI Fish and Wildlife Service, or species identified by the USDA Forest Service as sensitive (TES species).</p> <p>4.2.0.9 Prohibit collection of threatened, endangered, sensitive, and locally rare species except for research or educational purposes.</p> <p>4.2.0.10 Maintain supracanopy trees within 300 feet of lakes and rivers.</p>
Wildlife	<p>4.2.0.11 Retain existing hollow trees and hardwoods greater than 36 inches dbh during management activities.</p> <p>4.2.0.12 Retain den trees greater than 25 inches dbh within regeneration units.</p> <p>4.2.0.13 Restrict logging and skidding equipment from crossing vernal pools.</p> <p>4.2.0.14 Prohibit camping, equestrian, bike, and motorized use in permanent, maintained wildlife openings except by permit.</p> <p>4.2.0.15 Mitigate activities or developments that would substantially alter natural movement patterns of black bear. Ensure there are no net losses of black bear habitat. Future acquisitions for bear habitat shall be contiguous with key bear habitat.</p> <p>4.2.0.16 Within regeneration units, retain existing clumps of hardmast hardwoods equaling 10% of the total regeneration area. Give priority to dominant and co-dominant hardwoods, along with live cavity trees that are distributed across the unit.</p> <p>4.2.0.17 Retain the equivalent of two snags per acre distributed throughout regeneration units.</p> <p>4.2.0.18 Prohibit the cutting of snags for firewood.</p>

4.2.1 Wildlife, Fisheries, Botanical – <i>Prescription standards</i>	
<i>Management Prescription to which the standard applies.</i>	<i>Standard</i>
<ul style="list-style-type: none"> RCW HMA 	<p>4.2.1.1 Manage the RCW HMA in accordance with standards identified in the RCW Management Standards And Guidelines, and Recovery Plans.</p> <p>4.2.1.2 Map all RCW clusters, replacement stands and recruitment stands in a geographical information system (GIS).</p> <p>4.2.1.3 Establish replacement and recruitment stands at least 200 feet from system roads.</p> <p>4.2.1.4 Follow direction in the Final Environmental Impact Statement and Record of Decision for “Managing Southern Forests to Reduce Southern Pine Beetle Impacts.”</p> <p>4.2.1.5 Survey yearly all active and inactive RCW clusters including recruitment stands provisioned with artificial cavities.</p> <p>4.2.1.6 Conduct nest checks at 7-11 day intervals and conduct fledgling and adult checks to determine number and sex of birds.</p> <p>4.2.1.7 Color band all nestlings and adult birds.</p> <p>4.2.1.8 Survey all potential RCW nesting habitat in at least 10 percent of compartments annually and document new clusters and groups in a geographic information system.</p>
<ul style="list-style-type: none"> SIA (natural areas) 	<p>4.2.1.9 Allow for active management in RCW territories where RCW territories overlap Special Interest Areas, including tree harvest if necessary, according to standards outlined in the RCW Management Standards and Guidelines.</p> <p>4.2.1.10 Allow for site modification or translocation of species following major disturbances, such as stand replacement fire, or extensive hurricane blow down, to protect or maintain rare species if these disturbances negatively affect more than 25 percent of the species populations on the forest.</p>
<ul style="list-style-type: none"> Hardwood Cypress Wetlands 	<p>4.2.1.11 Prohibit construction of new wildlife openings in riverine swamp communities.</p> <p>4.2.1.12 Convert wildlife openings from annual grain plantings to grass/forb perennial plantings where openings are located within 500 feet of riverine swamp communities. Emphasize the planting of native annuals and perennials.</p>

4.3 Recreation

4.3.0 Recreation– <i>Forestwide standards</i>	
General	<p>4.3.0.1 Allow off-highway vehicles (OHVs) on designated routes and trails within the OHV area. Prohibit cross-country OHV use on the Forest and prohibit OHV use on all trails not designated for OHV use.</p> <p>4.3.0.2 Allow hiking, equestrian, and bike use on all gated classified roads unless a specific road is designated closed to one or more of these uses. Prohibit cross-country equestrian or bike use in the general forest areas except on trails designated for these uses.</p> <p>4.3.0.3 Allow hiking, equestrian, and bike use on all trails designated for those uses. Currently, all system trails are open to equestrian and bike use except the Cedar Point Tidelands trail, which is open to hiking only.</p> <p>4.3.0.4 Place signs on trail systems to indicate the types of use allowed.</p> <p>4.3.0.5 Provide improvements for hunters with disabilities as determined by a need analysis. Allow individuals who meet the “Disabled Access Program” criteria established by the North Carolina Wildlife Resources Commission to use these improvements.</p> <p>4.3.0.6 Manage recreation sites according to the appropriate recreation opportunity spectrum (ROS) setting.</p>
Scenery	<p>4.3.0.7 Consult with a landscape architect on timber sale activities in areas of very high or high scenic integrity objectives.</p> <p>4.3.0.8 Meet the scenic integrity objectives for the scenic classes within each management prescription according to scenic integrity objectives table (Table 4.3a).</p>

4.3.1 Recreation – <i>Prescription standards</i>	
<i>Management Prescription to which the standard applies.</i>	<i>Standard</i>
• Pocasin Lakes	4.3.1.1 Design facilities to meet the ROS class of the lake. Existing lakes are either semi-primitive or roaded-natural (See Appendix G, Figure G-1).
• Wilderness	<p>4.3.1.2 Post wilderness boundaries at sufficient distances to provide on-the-ground knowledge of the boundary line.</p> <p>4.3.1.3 Do not permit aircraft to land, except in life-threatening emergencies.</p> <p>4.3.1.4 Move from the existing settings in wildernesses toward primitive ROS conditions where practical.</p> <p>4.3.1.5 Allow the use of mechanized equipment in Wilderness for emergencies (FSM 2326.1).</p>
• River Corridors Eligible for Wild and Scenic River Status	4.3.1.6 Maintain the White Oak River and Brice Creek Corridors as eligible for study as National Wild and Scenic Rivers. Maintain or enhance their “outstandingly remarkable” values.
• Developed Areas	<p>4.3.1.7 Monitor designated swimming areas for compliance with State and Federal regulations.</p> <p>4.3.1.8 Post warning signs about potential hazards where the public accesses water.</p> <p>4.3.1.9 Design dispersed recreational facilities (trails, trailheads) to meet the ROS class of the area. Existing dispersed sites are either semi-primitive or roaded-natural (See Appendix G, Figure G-1.)</p> <p>4.3.1.10 Provide opportunities for bank fishing along principal canals.</p>
• SIA (natural areas)	4.3.1.11 Prohibit camping within 100 feet of limesink ponds in the Patsy Pond Limesink complex and Nine Foot Road/Roberts Road Limesink Ponds Special Interest Areas to protect unique habitat.
• OHV System	<p>4.3.1.12 Minimize impacts to natural resources from the OHV trail system.</p> <p>4.3.1.13 Design a trailhead to meet the ROS class of the area.</p> <p>4.3.1.14 Provide signage for the trailhead and trails, and clearly delineate travel routes on a map available to the public.</p>

Table 4.3a, Scenic Integrity Objectives for Management Prescription by Scenic Class.

<i>Management Prescription</i>	Landscape Character Theme ¹	Scenic Integrity Objective ² (numbers refer to scenic classes ³)			
		Very High	High	Moderate	Low
Pocosin lakes	NA		1-2	3-5	6-7
Wilderness	NE	1-7			
River Corridors Eligible for Wild and Scenic River Status	NE	1-7			
• Wild	NA		1-7		
• Scenic	NA		1-2	3-7	
• Recreational					
Hardwood Cypress Wetlands	NA		1-3	4-5	6-7
RCW HMA	NA		1-2	3-4	5-7
• Mixed pine	NA			1	2-7
• Pocosin patches	NA			1-2	3-7
Wildland Urban Interface	NA		1-3	4-7	
Upland Hardwoods	NA		1-3	4-5	6-7
Black Bear Habitat	NA		1	2	3-7
Developed Areas	NA		1	2-5	6-7
• Offices/Work Centers	NA			1-7	
• Electronic/Other Administrative Sites				1-2	3-7
• Roaded natural	NA		1	2-5	6-7
• Motorized	NA		1-2	3-5	6-7
• Rural, and roaded natural & semi-primitive	NA		1-2	3-4	5-7
Special Interest Areas					
• Natural Areas	NA		1-2	3-7	
• Heritage Resources	H/C		1-7		
Old Growth	NA		1-3	4-7	
OHV System	NA			1-3	4-7

¹Landscape Character Themes: C—Cultural; NE – naturally evolving; NA – natural appearing; H/C – historic/cultural

²Scenic Integrity Objectives:

- *Very High – (33,000 acres) Generally provides for ecological change only.*
- *High – (70,000 acres) Human activities are not visually evident. In high SI areas, activities may only repeat attributes of form, line, color, and texture found in the existing landscape character.*
- *Moderate – (14,000 acres) Human activities must remain visually subordinate to the attributes of the existing landscape character. Activities may repeat form, line, color, or texture common to these landscape characters, but changes in quality of size, number, intensity, direction, pattern, and so on, must remain visually subordinate to these landscape characters.*
- *Low – (44,000 acres) Human activities may dominate the existing landscape character. Activities must repeat form, line, color, or texture common to these landscape characters.*
- *Very Low - Human activities of vegetative and landform alterations may dominate the original, natural landscape character, but should appear as natural occurrences when viewed at background distances.*

³ Definitions of scenic classes can be found in Appendix F.

4.4 Silviculture

4.4.0 Silviculture – <i>Forestwide standards</i>	
Regeneration	<p>4.4.0.1 Regenerate mixed pine forests using natural regeneration where existing seed sources are adequate. Use prescribed fire prior to fall seed release when adequate seed source is available.</p> <p>4.4.0.2 Convert existing loblolly and pond pine forest types to longleaf pine forest type only when the average stand diameter is at least 12 inches DBH. If soils or other site factors cause loblolly or pond pine to experience severe mortality, such as in off site plantations, convert these stands to longleaf regardless of DBH.</p> <p>4.4.0.3 Limit size of openings created by even-aged and two-aged harvests to 40 acres; except with occurrence of natural catastrophes, such as hurricanes, wildfire, insect, or disease attack; or within the RCW HMA, limit regeneration openings to the standard identified in the RCW Management Standards and Guidelines; the current standard is 25 acres.</p> <p>4.4.0.4 Maintain a manageable stand between openings created by regeneration harvest except when using selection harvest methods or restoring longleaf pine. Classify a regeneration area as an opening until the reestablished stand has grown approximately 10 feet and free to grow.</p>
Thinning	<p>4.4.0.5 Target residual basal areas for thinning in pine dominated stands to:</p> <ul style="list-style-type: none"> • Wet savannas and flatwoods (loams) (LTP 0920), 50-70 square feet per acre. • Wet savannas and flatwoods (sands) (LTP 0921), 40-50 square feet per acre. • Mesic savannas and flatwoods (moderately well drained) (LTP 1022), 70-90 square feet per acre. • Mesic savannas and flatwoods (somewhat poorly drained) (LTP 1023) 50-70 square feet per acre. • Dry-mesic savannas (LTP 1124), 50-70 square feet per acre. • Xeric savannas (LTP 1225), 40-50 square feet per acre.
Clearcutting	<p>4.4.0.6 Use clearcut regeneration method only where it is essential to meet specific forest plan objectives and within the following circumstances:</p> <ul style="list-style-type: none"> • To establish, enhance, or maintain habitat for threatened, endangered, or sensitive species. • To enhance wildlife habitat. • To rehabilitate lands adversely impacted by events, such as fires, windstorms, or insect or disease attacks. • To preclude or minimize the occurrence of potentially adverse impacts of insect or disease infestations, windthrow, logging damage, or other factors affecting forest health. • To provide for the establishment and growth of desired trees or other vegetative species that are shade intolerant. • To rehabilitate poorly stocked stands due to past management practices or natural events. • To meet research needs. • To restore longleaf pine.
Pine straw harvesting	<p>4.4.0.7 Restrict pine straw harvest to longleaf pine stands that are at least 30 years old on mesic savannas and flatwoods (LTPs 1022 and 1023) and at least 40 years old on dry-mesic savannas (LTP 1124).</p> <p>4.4.0.8 Retain an organic layer during operation to minimize soil exposure.</p> <p>4.4.0.9 Designate loading areas and haul roads to minimize soil compaction.</p> <p>4.4.0.10 Restrict raking operations to dry conditions.</p> <p>4.4.0.11 Use raking equipment that minimizes tree damage.</p> <p>4.4.0.12 Prohibit pine straw harvesting in SIA (natural areas), designated old growth, and within ¼ mile of active RCW nest areas, and within 100 feet of rare (threatened, endangered, sensitive, and locally rare) plant species.</p>
Allowable Sale Quantity	<p>4.4.0.13 Limit chargeable timber volume to 8.76 million cubic feet from 2002 to 2012 from lands suitable for timber production.</p>

Cutting trees on land classified as not suitable for timber production	<p>4.4.0.14. Trees may be cut on land classed as not suitable for timber production to meet the following management objectives:</p> <ul style="list-style-type: none"> • Salvaging or sanitation harvest of trees or stands that are substantially damaged by fire, windthrow, insect or disease attack, or other catastrophes. • Providing safety of forest users, as in hazard-tree removal. • Meeting habitat objectives for threatened or endangered animals or plants, e.g., SIA (natural areas) that occur within the RCW HMA. • Improving wildlife and fish habitat. • Improving visual quality by opening scenic vistas or by increasing visual variety. • Constructing and maintaining roads and trails. • Providing auxiliary facilities, such as landings and skid trail corridors, associated with timber harvesting on adjacent acres selected for timber production, if these activities are compatible with management prescription objectives and desired conditions. • Fuel reduction and managing wildfires. • Supporting land-use permits and mineral leases. • Demonstrating and educating purposes.
General	4.4.0.15. Adhere to standards in the Vegetative Management in the Coastal Plain EIS as supplemented and the SPB EIS.

4.4.1 Silviculture – <i>Prescription standards</i>	
<i>Management Prescription to which the standard applies.</i>	<i>Standard</i>
<ul style="list-style-type: none"> • RCW HMA 	4.4.1.1 Manage these lands as suitable for timber production, with one exception: Manage pocosin ecological types within the RCW HMA as not suited for timber production.
<ul style="list-style-type: none"> • Pocosin Lakes • Wilderness • River Corridors Eligible for Wild and Scenic River Status • Hardwood Cypress wetlands • Wildland Urban Interface • Upland Hardwoods • Black Bear Habitat • Developed Areas • OHV System • SIA (natural areas) • SIA (heritage resources) • Old Growth 	<p>4.4.1.2 Manage these lands as not suitable for timber production, with the following clarifications:</p> <ul style="list-style-type: none"> • Pond pine forest types within the RCW HMA are suited for timber production as long as 1/3 is retained in old growth condition.
<ul style="list-style-type: none"> • River Corridors Eligible for Wild and Scenic River Status 	4.4.1.3 Allow tree removal only in river segments classified as recreational to maintain or enhance the outstandingly remarkable resource values of the area or to provide access for recreation use.
<ul style="list-style-type: none"> • Hardwood Cypress 	4.4.1.4 Do not salvage timber in units less than 1.0 acre. When salvage occurs, leave 25 percent of the downed timber.

<ul style="list-style-type: none"> wetlands Upland Hardwoods 	Salvage only trees that are down. Leave leaning and/or broken-topped trees for future snags and den trees. When salvage occurs, regeneration efforts may include site preparation for natural regeneration. Supplement by planting appropriate species when natural regeneration is not adequate. Select from the following species: water oak, laurel oak, willow oak, overcup oak, cherrybark oak, swamp chestnut oak, white oak, hickory species, American beech, hackberry, blackgum, swamp tupelo, water tupelo, green ash, bald cypress, and American holly.
<ul style="list-style-type: none"> Old Growth 	<p>4.4.1.5 Trees may be cut for purposes of human safety or if it will enhance old growth structure and is limited to the following categories: 1) felling of overstory trees in 1/10 acre or less groups to improve conditions for natural or artificial regeneration, 2) thinning of mid-canopy and low-thinning of canopy co-dominates to enhance growth of dominant trees, 3) midstory control in RCW habitat, 4) reduce risks to adjacent stands from insect attacks or disease conditions.</p> <p>4.4.1.6 Overstory trees may be felled if there is a need for large downed material to improve habitat structure for fish in streams.</p> <p>4.4.1.7 Prohibit permits for removal of old trees, snags, or downed logs if they will alter old-growth structure.</p>
<ul style="list-style-type: none"> RCW HMA 	4.4.1.8 Pine restoration will occur in existing hardwood stands only in the following landtype phases: LTP 1022 (Moderately well drained longleaf pine), LTP 1124 (well-drained longleaf pine), and LTP 1225 (excessively well-drained longleaf pine).
<ul style="list-style-type: none"> SIA (natural areas) 	4.4.1.9 Allow only cut and fell operations in SIA (natural areas) to provide for safety of forest users, or where disease or insect infestations threaten adjacent private or public lands. Exceptions to this standard include allowing necessary removal of trees if the recovery of a threatened or endangered species is compromised, or if a hazard tree is in a developed area.

4.5 Fire

4.5.0 Fire – <i>Forestwide standards</i>	
General	<p>4.5.0.1 When deciding to use fire, human health and safety shall be the highest priority, with consideration of resource values being secondary.</p> <p>4.5.0.2 Provide documentation of economic efficiency to develop and support the Forest Fire Management Program.</p> <p>4.5.0.3 Use the most current nationally approved qualifications guide for standards of staffing all fire activities.</p> <p>4.5.0.4 Complete Fire Management Plans for all managed lands. Plans will be updated annually.</p> <p>4.5.0.5 Use an interdisciplinary approach to developing prescribed fire objectives and operational plans.</p> <p>4.5.0.6 Include the protection of snags and cavity trees as an objective of all prescribed fire burn plans.</p>
Air Quality	<p>4.5.0.7 Do not ignite a prescribed fire if, during any portion of the burning period, the Dispersion Index¹ is predicted to be >30, and/or the Low Visibility Occurrence Risk Index¹ is >3, especially if significant amounts of residual smoke are expected to be present at night.</p> <p>4.5.0.8 Use VSMOKE¹ and/or VSMOKE GIS² and other computer programs as they are available to plan prescribe burns on the forest.</p>
Safety	<p>4.5.0.9 Include safety provisions as the first objective of all fire management operational plans.</p> <p>4.5.0.10 A qualified Safety Officer will be assigned to all fire operations having more than 25 people assigned to operations branch.</p>
Fire lines	<p>4.5.0.11 In all fire operations emphasize the use of naturally occurring barriers, or existing human-created structures, such as roads, canals, or utility corridors.</p> <p>4.5.0.12 Minimize evidence of human caused disturbance in fire line location and construction during suppression and prescribed fire operations. Adjustments to fire line location, up to approximately +/-10% of area change, are preferred to ground disturbing activities even when the readjustment may impose into an area prescribed for less fire use.</p> <p>4.5.0.13 Rehabilitation of fire lines will be included in the objectives of fire operational plans. The standards of rehabilitation will be developed in coordination with the district or forest resource specialists.</p> <p>4.5.0.14 Mitigate impacts to heritage resources, T&E species, and sensitive species when constructing fire lines. Document the rationale for line location if impacts to an area result from a safety related decision.</p> <p>4.5.0.15 Prohibit the use of plowed fire lines in ecotones between pine savannas and pocosins.</p>
Wilderness and other sensitive areas	<p>4.5.0.16 Use the Minimum Requirement Decision Guide (Arthur Carhart National Wilderness Training Center 2002) when determining the extent of options allowed as part of the use of prescribed fire in Wilderness or in other areas designated as sensitive. Evidence of any pre-treatment disturbance must be eliminated by the fire occurrence.</p>
Wildland Urban Interface	<p>4.5.0.17 Activity within the Wildland Urban Interface zone will consider the implications to the adjacent Management Prescriptions. Infringement on the prescriptions of adjacent lands is allowed if required to ensure human health and safety, and will be documented within the operational plan prior to approval.</p>

¹ Lavdas 1996

² Jackson, Lavdas, and Loeberger 1997

4.5.1 Fire – <i>Prescription standards</i>	
<i>Management Prescription to which the standard applies.</i>	<i>Standard</i>
<ul style="list-style-type: none"> River Corridors Eligible for Wild and Scenic River Status 	4.5.1.1 Allow the use of fire in all eligible or designated river segments to maintain or enhance the outstandingly remarkable resource values of the area.
<ul style="list-style-type: none"> Hardwood Cypress Wetlands Upland Hardwoods 	4.5.1.2 Restrict the use of fire in riverine swamp communities. When adjacent stands are burned, minimize tree mortality by using low intensity firing techniques. 4.5.1.3 Use only dormant season burning in hardwood restoration stands. Avoid prescribed burning in hardwood restoration stands until the majority of hardmast producing trees, including regeneration, are at least 4-6 inches DBH on average.
<ul style="list-style-type: none"> Black Bear Habitat 	4.5.1.4 Limit prescribed burning impacts to no more than 30% of suitable bear habitat in any single year. Prior to dormant season burning, survey and document findings of impact to bear populations inhabiting the proposed burn area.
<ul style="list-style-type: none"> Developed Areas 	4.5.1.5 Do not prescribe burn adjacent to developed sites unless the site is closed to the public.

4.6 Transportation System

4.6.0 Transportation System – <i>Forestwide standards</i>	
Road closures	4.6.0.1 Close newly constructed traffic service level D roads when management activities are complete, except when roads are constructed specifically for public recreation access.
Prioritization of road closures	4.6.0.2 Prioritize roads for seasonal closure where traffic volumes are low but the patterns of use by hunters or visitors at developed sites are stable over time. 4.6.0.3 Prioritize the closing of existing transportation system and non-system roads where the following conditions exist: <ul style="list-style-type: none"> • unregulated target practice and other illegal activities near urban interface areas, and secondly, away from urban interface areas • illegal trash dumps • open roads in bear habitat • open roads in restoration core areas for wild turkey • open roads adjacent to RCW nest sites • open roads with erosion problems • open roads with high maintenance costs and low traffic volume • roads within 1/4 mile of wilderness areas • roads near endangered or threatened species, SIAs, or wetlands.

4.6.1 Transportation System – <i>Prescription standards</i>	
<i>Management Prescription to which the standard applies.</i>	<i>Standard</i>
<ul style="list-style-type: none"> • River Corridors Eligible for Wild and Scenic River Status 	4.6.1.1 Do not permit road construction in river segments eligible for classification as wild. Roads should not be seen in river segments eligible as scenic. In river segments eligible as recreational, design roads to minimize the amount seen. 4.6.1.2 If road construction is necessary and allowable within river corridors eligible for wild and scenic river status, locate and construct roads to minimize erosion potential.
<ul style="list-style-type: none"> • Hardwood Cypress Wetland • Upland hardwoods 	4.6.1.3 Prohibit construction of newly developed recreational facilities, roads, or trails for motorized use, except for canoe and fishing access points to streams and rivers.
<ul style="list-style-type: none"> • RCW HMA 	4.6.1.4 Within RCW clusters, replacement stands and recruitment stands, close all unauthorized roads in nest areas during the next 10 years (2002-2012). 4.6.1.5 Prohibit construction of roads, powerlines, or pipelines in nest areas. 4.6.1.6 During the April-July nesting season, prohibit reconstruction or maintenance of roads, power lines, or pipelines, except for emergency purposes. Road grading for maintenance of the road prism or mowing rights-of-way are allowed on system roads.
<ul style="list-style-type: none"> • Black Bear Habitat 	4.6.1.7 Do not open any existing closed roads in bear habitat for public access. 4.6.1.8 Restrict new recreation uses with high potential for disturbance from the central core of the black bear habitat prescription.
<ul style="list-style-type: none"> • Developed Areas 	4.6.1.9 Prohibit off-highway vehicles.
<ul style="list-style-type: none"> • SIA (natural areas) 	4.6.1.10 Prohibit construction of roads except for the purpose of research in SIA (natural areas).

4.7 Special Uses

4.7.0 Special Uses – <i>Forestwide standards</i>	
General	<p>4.7.0.1 Deny applications for new special uses or amendments to existing uses when the proposed uses are inconsistent with the CNF LRMP, are in conflict with other forest management objectives or applicable Federal statutes and regulations, or can reasonably be accommodated on non-National Forest System lands. The one exception is that First Amendment group uses may not be denied on this basis.</p> <p>4.7.0.2 Do not authorize the use of National Forest System lands because it affords the applicant a lower cost and less restrictive location when compared with non-National Forest System land.</p>
New applications	<p>4.7.0.3 Respond first to those relating to public safety, health, and welfare (e.g., highways, powerlines, and public service improvements), and then secondly to those contributing to public benefits associated with national forest resources, and those that benefit only private users, e.g., road permits, rights-of-way for powerlines, telephones, and waterlines.</p> <p>4.7.0.4 Require the applicant to pay processing costs in accordance with established laws and regulations such as the Granger-Thye Act, and the Federal Land Management Policy Act.</p> <p>4.7.0.5 Convey or exchange land to permit holders under special-use authorizations and occupied by substantial structural improvements when overall goals and objectives can be met.</p>
Non-commercial groups exceeding 75 people	<p>4.7.0.6 Require permits for all non-commercial groups exceeding 75 people, so that impacts to forest resources, public health and safety, and competing uses and activities on National Forest System lands can be minimized. Group use sites must be designated prior to the issuance of new authorizations. The following areas are designated group use areas: Pine Cliff Recreation Area, Sheep Ridge Lane Area, Waterfowl Impoundment Area during non-hunting seasons, Brown Road Area, Sanders Branch Area.</p>
Sanitary systems	<p>4.7.0.7 The responsible officer shall work with state or local government officials to locate existing solid and liquid waste disposal sites on non-Federal land. No new uses will be authorized on National Forest System lands.</p> <p>4.7.0.8 Non-hazardous solid waste transfer stations facilities may be approved provided other non-Federal sites are not reasonably available.</p>
Communication sites	<p>4.7.0.9 Designate communication sites and approve site plans prior to issuance of new authorizations. The following areas are designated communication sites: Tower Range Road, Pine Grove, Millis Swamp, and the work center.</p> <p>4.7.0.10 Require Forest Supervisor's review and approval of applications for non-designated sites prior to the issuance of a special-use permit.</p> <p>4.7.0.11 Communication site designations are waived from resource monitoring when the forest supervisor determines there are no significant impacts.</p>
Recreation residences	<p>4.7.0.12 New recreation residences shall not be authorized. Permits shall expire under existing terms or by the breach of any of the terms and conditions of the permit and other applicable law. New permits may be issued to current permit holders under the terms and provisions of the existing permit, upon expiration, death of a spouse, or divestiture of ownership.</p> <p>4.7.0.13 Do not approve additional structural improvements to permitted sites that increase the size of the residence, significantly increase the value, or are considered optional additions, such as boat docks, storage buildings, or porches. Existing improvements specifically named on the face of the permit are to be maintained in accordance with standards and provisions of the permit.</p> <p>4.7.0.14 Use of these permitted sites as a principal place of residence is prohibited, but they must be occupied at least 15 days each year for noncommercial recreation use.</p>

4.7.1 Special Uses – <i>Prescription standards</i>	
<i>Management Prescription to which the standard applies.</i>	<i>Standard</i>
<ul style="list-style-type: none"> River Corridors Eligible for Wild and Scenic River Status 	4.7.1.1 Do not permit utilities in river segments classified as wild. Do not allow utilities such as pipelines and powerlines in scenic and recreational river segments unless there is no feasible alternative location. If a utility must be located in a scenic or recreational segment, minimize impacts to the river and corridor.
<ul style="list-style-type: none"> RCW HMA 	4.7.1.2 Clearings are not allowed within 1/4 mile of active clusters until MIL 2 level is reached.
<ul style="list-style-type: none"> River Corridors Eligible for Wild and Scenic River Status Black Bear Habitat 	4.7.1.3 Do not permit mining.
<ul style="list-style-type: none"> Developed Areas 	4.7.1.4 Stipulate no surface occupancy for all mineral leases.

4.8 Lands – Land Ownership Adjustment

4.8.0 Lands - Land Ownership Adjustment – <i>Forestwide standards</i>	
General	<p>4.8.0.1 Use the land adjustment plan and map in Appendix D to identify potential areas for land acquisition and conveyance. Changes to the map may only be made by the Forest Supervisor.</p> <p>4.8.0.2 Acquire rights of way for existing and proposed forest development roads and trails.</p> <p>4.8.0.3 Determine management direction for new acquisitions and exchanges by identifying in which Management Prescription the parcel is located. Use the landtype(s) in which it is classified (Appendix 1, ECS), and the reference condition to which it best matches (Chapter 3.0) for determining the management prescription by which the parcel is to be managed.</p> <p>4.8.0.4 The new land is suitable for timber production if it is classified as management prescription RCW HMA and it is not part of an RCW nest area. However, if the new acquisition is a pocosin ecological type, it is not suited for timber production even if it occurs within the RCW HMA (see standard 4.4.1.1).</p> <p>4.8.0.5 Use the listed priority guidelines (Table 4.8a) to determine land ownership adjustment proposals and decisions.</p> <p>4.8.0.6 In SIAs, consider only those land exchange proposals that would result in no net loss of values for which the SIA was established.</p> <p>4.8.0.7 Acquire or exchange access with other agencies, States, counties, and private interests to meet management objectives of all ownerships.</p>

Table 4.8a. Guidelines for determining land ownership adjustment proposals and decisions.
(Bullets under each category are not listed in any order of priority)

Highest priority for acquisition	<ul style="list-style-type: none"> • Riparian ecosystems on water frontage, such as lakes and major streams. • Existing or potential habitats that support, in their current condition, federally listed endangered or threatened fish, wildlife, plant species, or Forest Service sensitive species. • Historical or cultural resources that are threatened by change or use or when management may be enhanced by public ownership. • Areas needed to enhance or promote watershed improvements that affect the management of national forest riparian areas. • Environmentally sensitive areas such as wetlands, old-growth forests, and linkages needed for habitats with other public lands. • Land primarily of value for outdoor recreation purposes and land needing protection for aesthetic purposes. • Land needed for protection and management of administratively and Congressionally-designated areas. • Land needed as a buffer for specific purposes listed above.
Priority 2 for acquisition	<ul style="list-style-type: none"> • Key tracts of an ecosystem that are not urgently needed but will promote more effective management of the ecosystem and will meet specific needs for vegetative management, valuable watershed management, research, public recreation, or other defined management objectives. These tracts will consolidate CNF landownership. • Land needed to protect resource values by eliminating or reducing fire risks, soil erosion, and occupancy trespass cases. • Land needed to reduce expenses of both the Forest Service and the public in administration and utilization. Reductions may be in energy expenditures, as well as other common efficiencies. These tracts will consolidate CNF landownership.
Criteria for Federal Land to be conveyed	<ul style="list-style-type: none"> • Small parcels intermingled with private land. • Parcels that will serve a greater public need in State, county, city, or other federal agency ownership. • Parcels isolated from other National Forest System lands. • Lands under special-use authorizations and occupied by substantial structural improvements. • Occupancy trespass cases involving highly valuable structure improvements. • Parcels within major blocks of private land, the use of which is substantial for non-forest purpose. • Parcels that have boundaries, or portions of boundaries, with inefficient configurations, such as, projecting long, narrow strips of land. • Land inside or adjacent to communities or intensively developed private land, and chiefly valuable for non-national forest purposes.

4.9 Heritage Resources

4.9.0 Heritage Resources – <i>Forestwide standards</i>	
General	<p>4.9.0.1 Inventory heritage resources prior to ground disturbance. Avoid disturbing sites until evaluated.</p> <p>4.9.0.2 Keep site locations confidential.</p> <p>4.9.0.3 Nominate significant archeological sites to the National Register of Historic Places and protect all heritage resources listed or eligible for the register.</p> <p>4.9.0.4 Stipulate heritage resource protection in special-use permits and contracts.</p> <p>4.9.0.5 Protect significant archeological sites during prescribed burning activities. Check locations prior to igniting burns and mitigate potential adverse effects to these sites.</p> <p>4.9.0.6 Avoid disturbing American Indian sacred sites and traditional cultural properties.</p> <p>4.9.0.7 Preserve sites from natural deterioration, and deterioration resulting from hurricanes, floods and other natural disasters.</p> <p>4.9.0.8 Protect sites from vandalism and looting.</p>

4.9.1 Heritage Resources – <i>Prescription standards</i>	
<i>Management Prescription to which the standard applies.</i>	<i>Standard</i>
<ul style="list-style-type: none"> SIAs (Heritage Resources) 	4.9.1.1 Consult the forest archeologist before taking management actions in the 11 designated HR areas.

Chapter 5: Monitoring and Evaluation

5.1: Purpose of Monitoring and Evaluation

Monitoring and evaluation are activities that provide information to determine whether programs and projects are meeting forest plan direction, and whether the cost anticipated to implement the plan coincides with actual costs. Direction for the monitoring and evaluation of forest plans is found in FSM 1922.7, FSH 1909.12.6, and 36 CFR 219.12(k).

Monitoring is observing or measuring results for a specific purpose, such as compliance with applicable laws and regulations, or addressing issues. Monitoring measures:

- Progress in forest plan implementation;
- How well the forest plan meets desired conditions, goals, and objectives;
- Whether management standards are appropriate for meeting the forest's outputs and environmental protection; and
- Whether assumptions used in developing the forest plan reflect actual conditions, new information, and/or legal requirements.

Monitoring also increases and improves the level of scientific information available by which to measure the effects of management on sustaining communities and ecosystems.

Forest plan monitoring is required to:

- Quantitatively estimate a comparison of planned versus actual outputs and services;
- Document the measured effects of prescriptions, including significant changes in productivity of the land;
- Document costs associated with carrying out the planned management prescriptions as compared with costs estimated in the forest plan;
- Determine if lands are adequately restocked;
- Determine, at least every ten years, if lands identified as not suited for timber production have become suited;
- Determine if maximum size limits for harvest areas should be continued;
- Ensure that destructive insects and disease organisms do not increase to potentially damaging levels following management activities.

Evaluation of data collected during monitoring assesses the significance of observations or measured results. The assessment of significance is periodically made by managers and interdisciplinary team members, and reported in the annual *Monitoring and Evaluation Report for the National Forests in North Carolina*. Evaluation determines if planned conditions or results are being attained, and if they are within forest plan direction. When a situation is identified as being outside acceptable variability, changes to the forest plan may need to occur. Evaluation, therefore, serves two functions:

- It identifies when a change in management practices is needed; and
- It provides a means to adjust the forest plan to keep it dynamic and responsive to changing conditions.

5.2: Levels of Forest Plan Monitoring

Monitoring the forest plan may occur at three distinct levels. These are:

- Implementation monitoring;
- Effectiveness monitoring; and
- Validation monitoring.

Implementation monitoring is meant to answer the question: *Are proposals being initiated and implemented based on what the forest plan directs?* It determines if plans, prescriptions, projects, and activities are proposed and implemented according to forest plan direction, requirements, and standards. Evaluation of implementation monitoring may require adjustment of prescriptions and targets, or changes in forest plan or project administration (FSM 1922.7).

Effectiveness monitoring is meant to answer the question: *Are management actions moving the forest towards specified desired conditions?* It determines whether plans, prescriptions, projects, and activities are effective in achieving movement toward, or maintenance of, the desired conditions. Evaluation of effectiveness monitoring is used to adjust forest plan objectives, targets, prescriptions, standards, conservation practices, mitigation measures, and other best management practices. Results could lead to a change or amendment to the forest plan (FSM 1922.7).

Validation monitoring is meant to answer the question: *Are assumptions that were used in developing the forest plan valid, or are there better ways to meet the goals and objectives?* This monitoring is designed to ascertain whether the initial assumptions and coefficients used when developing the forest plan are correct. Evaluation can result in amendment of forest plans and may be used to recommend changes in laws, regulations, and policies that affect both the plan and project implementation (FSM 1922.7).

5.3: The Monitoring Plan: Five Categories of Questions

The monitoring plan consists of monitoring questions, items to be measured (actions, resources or effects), the frequency of measurement, and the responsibility for reporting. Monitoring questions were developed based on the revised forest plan objectives, goals, and standards. Baseline data and information are provided in Section 5.4 of this chapter. Monitoring questions help to determine whether the revised forest plan decisions are being implemented, and whether the decisions are effective and valid. Monitoring task sheets are included as part of the monitoring plan (Appendix L), and provide more detail about answering the monitoring questions.

The monitoring plan is organized into five categories of questions. Each monitoring question addresses a group of goals, objectives, or standards. There are 2 parts to each category: a) questions referring to desired outcomes (validation or effectiveness), and b) questions about the rate of implementation of goals and objectives that likely contribute toward achieving desired outcomes.

Available baseline data will be used to compare changes in the future resulting from management actions and other natural processes. Coordinating efforts with existing resource inventories may minimize duplication in data collection and reporting (FSM 1922.71). The items that will be measured and the frequency of collection, capture what will be used to incrementally monitor success, failure or some degree of either, and the duration between data collection.

The monitoring questions are organized into the following major topics:

- MIS population trends and habitats;
- Habitats least affected by management activities;
- Public use and customer satisfaction;
- Sustaining local communities; and
- Project implementation.

5.3.1 Monitoring Questions

5.3.1.1. Monitor MIS Population Trends and Habitats.

Question: 1a) What are the population trends of the management indicator species? How do they compare with planned goals? 1b) Of the goals and objectives that likely contribute toward or affect the population trends, what are the rates of implementation?

The primary direction of the CNF Plan is restoring biological diversity. MIS were chosen to represent effects of management activities. Five species have been chosen as management indicator species, and will be tracked by monitoring population trends. These species are RCW, longleaf pine, wiregrass, wild turkey, and black bear. These species exist on the landtypes where most active management of habitats will occur. For more information on MIS selection, refer to Section 5.4 and the FEIS, Appendix G.

5.3.1.2. Monitor Habitats Least Affected by Management Activities

Question: 2a) On landtypes where planned management actions are relatively infrequent and low impact, what are the habitat conditions? Are plan objectives being met? 2b) Of goals and objectives likely to contribute towards the conditions of these habitats, what are the rates of implementation?

The CNF Plan proposes active management in predominantly 5 ecological landtypes (Ecological Classification System, Appendix A). Within these landtypes and associated management prescriptions, individual species are monitored to measure effects (Management Indicator Species). The remaining 3 landtypes either have no management activities proposed that alter habitat, or the management activities are limited in amount and distribution to only have minor localized effects. Rather than monitoring MIS trends for effects of management activities, the change in habitat will be monitored.

The landtypes that will be monitored are lake and stream swamps, tidal streams and estuaries, and maritime ridges and dunes. These landtypes were allocated to the hardwood cypress wetland and pocosin lake management prescriptions.

5.3.1.3. Monitor Public Use and Consumer Satisfaction.

Question: 3a) What amount and kinds of public use activities are occurring on the CNF and how satisfied are people with their experiences? 3b) Of goals and objectives that would contribute toward the trends of public use and satisfaction, what is the rate of implementation?

In 1998 a recreation sampling system was developed by research and forest staff that would be cost effective and provide reliable recreation use information at the forest, regional, and national level. The National Visitor Use Monitoring (NVUM) project is the permanent sampling protocol that was developed. It was implemented nationally to gauge the importance of, and satisfaction with, recreational opportunities within the national forest system. The NVUM is administered once every four years on every national forest in the country. The National Forests in North Carolina participated in the NVUM project from October 2000 through September 2001. The results collected are applicable only at the NFsNC level, and not intended to be accurate at the district or site level (NVUM Report June 2002). The sampling results can therefore not be applied specifically to the Croatan National Forest. To answer what and how much people are visiting the Croatan National Forest, and to what extent they are enjoying the experience, a survey specific to the CNF is needed.

Using the sampling protocol as the NVUM utilized, information will be collected for the Croatan National Forest sometime between 2002 and 2006, when the next scheduled sampling will occur for all the National Forests in North Carolina. Questions that pertain specifically to the CNF will be developed to focus the results on answering the monitoring question. The preliminary sample design, sampling unit selection, sample size and variability, and survey implementation must be developed in coordination with District, Forest and Research input.

5.3.1.4. Monitor Local Community Needs and Community Actions

Question: 4a) Are local communities attaching special significance to the natural and cultural attributes of the CNF as contributing to their well-being, and if so, how is this attachment exhibited through community actions? 4b) Of goals and objectives that would contribute toward creating a sense of place for local communities, what are the rates of implementation?

People can form a strong bond of attachment to the land, the people in their community, and their culture. This attachment has been called a sense of place. Communities with strong attachment to a place can articulate what special attributes contribute to their perception of well-being. These communities tend to take special precautions to preserve those attributes. The CNF has many natural and cultural attributes that may contribute toward a positive sense of place. To recognize this area as a special place, a collaborative effort among federal and state agencies with local communities and governments is needed.

5.3.1.5. Design and Implementation of Projects

Question: 5a) Are projects being designed to achieve desired conditions of the management prescriptions? 5b) Are projects being implemented according to decisions made through the NEPA process, including plan standards?

The Forest Service currently has multiple methods of reporting accomplishments every year. Each program area tracks projects that are initiated, ongoing, or implemented during the fiscal year. In addition, reviews of programs are conducted yearly that monitor project implementation and whether the projects are according to Forest Plan direction, including Plan standards such as the requirement to follow NC Best Management Practices for Forestry, and the NC Forest Practice Guidelines Related to Water Quality. Regional and Washington Office reviews as well as Forest-wide reviews take place periodically as an overall assessment of the direction in which resource management is headed.

5.3.1 Monitoring Questions and Measures

The following table displays the monitoring questions and the goals, objectives and measures associated with addressing the question.

Table 5.3.1. Monitoring questions and measures with corresponding goals and objectives.

Monitoring Question: 1a) What are the population trends of the management indicator species? How do they compare with planned goals?				
<i>Goal</i>	<i>Objective</i>	<i>Item(s) to be Measured</i>	<i>Frequency and Method of Reporting</i>	<i>Responsibility</i>
2.1.1	2.1.1.1–2.1.1.5	RCW Population Trends	Annual Report	TES Manager
		Potential Breeding Pairs	Annual Report	TES Manager
	2.1.1.6	Longleaf Pine Population Trends	Annual Report	Forest Silviculturist
	2.1.1.7	Wiregrass Population Trends	Annual Report	TES Manager
2.1.5a	2.1.5.5	Black Bear Population Trends	Annual Report	Forest Biologist
2.1.7	2.1.7.3	Wild Turkey Population Trends	Annual Report	Forest Biologist
Monitoring Question 1b) Of the goals and objectives that likely contribute toward or affect the population trends, what are the rates of implementation?				
<i>Goal</i>	<i>Objective</i>	<i>Item(s) to be Measured</i>	<i>Frequency and Method of reporting</i>	<i>Responsibility</i>
2.1.2- 2.1.3	2.1.2.1	Element Occurrences, type, number, and condition	Annual Report of BCD Database	District Biologist
	2.1.2.3			
	2.1.3.1-2.1.3.3			
	2.1.2.2	Lightning caused fires allowed to burn in SIAs	Annual Report	District FMO
2.1.5b	2.1.5.1-2.1.5.4	Timber salvaged (ac) in SIAs	TRACS Database	District Silviculturist
		Within bear habitat prescription determine:	WFRP report-annually	District Biologist
		• % seedling /shrub successional stage		
		• % mature successional stage		
2.1.7	2.1.7.1	Trend in open road density		District silviculturist
		• Acres of soft mast		
		Within upland hardwood prescription, acres in mature successional stage		
	2.1.7.2	Acres of upland hardwood restored		District silviculturist
2.4.1a- 2.4.1e	2.4.1.1	Acres of regeneration by method	TRACS database PEP	District Silviculturist
		• Acres by other restoration techniques		
		• Acres meeting seedling density	TRACS	District Silviculturist
		• Acres thinned in RCW HMA		
2.4.2.	2.4.2.1	• Acres thinned for hardwood restoration	TIMS database	District Silviculturist
		• Acres salvage sure to natural disturbance		
		Pine Straw monitoring plan prepared for effects on herbaceous plants and shrubs		
		• Acres of pine straw harvested and follow-up treatments		
2.5.1a 2.5.1b	2.5.1.3	Fuel load reduction burns (acres by landtype)	Annual Report	District FMO
2.5.2a	2.5.2.1	Acres longleaf burned, in what season, and years since previous fire (wildfire or prescribed)	Annual Report	District FMO
2.5.2b	2.5.2.2	Completion of fire use plan for Millis Rd Savanna Natural Area	Report at 2-year intervals	District Biologist
2.6.1a	2.6.1.2	Trend in closure and restoration of unauthorized routes	INFA Report-annually	District Recreation Manager

Monitoring Question 2a: On landtypes where planned management actions are relatively infrequent and low impact, what are the habitat conditions? Are plan objectives being met?				
<i>Goal</i>	<i>Objective</i>	<i>Item(s) to be Measured</i>	<i>Frequency and method of reporting</i>	<i>Responsibility</i>
2.1.4	2.1.4.1-2.1.4.2	Change in old growth condition <ul style="list-style-type: none"> • Acres mapped by old growth type • Acres disturbed by management activity 	Report at 2-year intervals NRIS-Terra Database	District biologist
2.1.6	2.1.6.1-2.1.6.2	Change in hardwood cypress wetlands prescription area <ul style="list-style-type: none"> • Number of vegetation plots established, inventoried, and evaluated • Number of bird points inventoried, and results incorporated into regional- scale evaluation 	Report at 2-year intervals NRIS- Terra NRIS-Fauna	District biologist
2.1.8	2.1.8.1-2.1.8.3 2.1.8.5	Change in aquatic condition <ul style="list-style-type: none"> • Measure of salinity, Ph, dissolved oxygen, conductivity 	NRIS- water database	Forest fisheries biologist
Monitoring Question 2b: Of goals and objectives likely to contribute toward affecting these habitat conditions, what are the rates of implementation?				
<i>Goal</i>	<i>Objective</i>	<i>Item(s) to be Measured</i>	<i>Frequency and method of reporting</i>	<i>Responsibility</i>
2.1.3a 2.1.3b	2.1.3.4 2.1.3.5	<ul style="list-style-type: none"> • Acres restored of canebreak, marsh, maritime forest, and Atlantic White Cedar • Acres of maritime forest and coastal prairie maintained 		
2.1.8	2.1.8.4	Hydrologic Restoration (acres)	NRIS- water	Forest Hydrologist

Monitoring Question 3a: What amount and kinds of public use activities are occurring on the CNF and how satisfied are people with their experiences?				
<i>Goal</i>	<i>Objective</i>	<i>Item(s) to be Measured</i>	<i>Frequency and method of reporting</i>	<i>Responsibility</i>
2.2.1-2.2.2	2.2.1.2-2.2.2.4	Conduct user survey on CNF using national recreation user survey protocols	NRUS survey for CNF (1 study)	Forest recreation manager
2.3.1a-2.3.1.b	2.3.1.1	<ul style="list-style-type: none"> Change in condition of roadless areas (change in ROS settings due to management activity); Change in wilderness conditions (change in fuel loadings and ROS settings) 	Annual report	Forest recreation manager
2.3.2	2.3.2.1 2.3.2.3	<ul style="list-style-type: none"> Condition of river corridors eligible for Wild and Scenic River status (change in settings due to management activity); 	Annual Report	Forest recreation manager
Monitoring Question 3b: Of goals and objectives that would contribute toward the trends of public use and satisfaction, what is the rate of implementation?				
<i>Goal</i>	<i>Objective</i>	<i>Item(s) to be Measured</i>	<i>Frequency and method of reporting</i>	<i>Responsibility</i>
2.2.1	2.2.1.2 2.2.1.3	Trend in capacity for: <ul style="list-style-type: none"> Highly developed areas Water-based – moderate development Rustic development Group camps 	INFRA (annual)	District recreation manager
	2.2.1.4	Trend in miles of hiking, biking, and equestrian trail; and scenic byways	INFRA (annual)	District recreation manager
	2.2.1.5	Trend in miles of OHV trails in designated area, condition and uses	INFRA (annual)	District recreation manager
2.2.2	2.2.2.1 - 2.2.2.3	Change in improvements for wildlife/wetland waterfowl viewing and hunting opportunities	INFRA (annual)	District recreation manager
	2.2.2.4	Change in fishing opportunities provided	INFRA (annual)	District recreation manager
2.3.1b	2.3.1.2	Trend in miles of hiking and equestrian trails		
2.3.1c	2.3.1.3	Number sign-in boxes at wilderness stations and number of people registered	INFRA (annual)	District recreation manager
	2.3.1.4	Completion of WIS	INFRA (annual)	District recreation manager

Monitoring Question 4a: Are local communities attaching special significance to the natural and cultural attributes of the CNF as contributing to their well-being, and if so, how is this attachment exhibited through community actions?				
<i>Goal</i>	<i>Objective</i>	<i>Item(s) to be Measured</i>	<i>Frequency and method of reporting</i>	<i>Responsibility</i>
2.6.1a	2.6.1.4	Trash sites cleaned and maintained through community actions	Annual Report	District Ranger
2.7.3a 2.7.3b	2.7.3.1	Number of action plans developed and implemented in collaboration with local communities and governments	Annual Report	District Ranger
	2.7.3.2	Number of special events sponsored through collaborative efforts of local communities and other government agencies. Number of events specifically sponsored for environmental awareness.	Annual Report	District Ranger
2.7.3c	2.7.3.3	Number of sites monitored; number of sites stabilized; number of sites investigated; number of sites interpreted; changes in site conditions; number of sites protected from vandalism	Annual Report	District Ranger
Monitoring Question 4b: Of goals and objectives that would contribute toward creating a sense of place for local communities, what are the rates of implementation?				
<i>Goal</i>	<i>Objective</i>	<i>Item(s) to be Measured</i>	<i>Frequency and method of reporting</i>	<i>Responsibility</i>
2.3.1d	2.3.1.5	Acres of Wilderness burned; WUI treated by method (acres)	Annual Report	District FMO
2.5.1	2.5.1.2	WUI treated by method (acres) Wildfire: acres, location, and spread	Annual Report	District FMO
	2.5.1.3	Fuel load reduction/burns (acres by landtype)	Annual Report	District FMO
	2.5.1.1 2.5.1.4	Number of permanent firefighters, detailers, and injuries due to fire activities	Annual Report	District FMO
2.5.2c	2.5.2.3	Fire management Plan completed and used for implementation	Annual Report	Forest Fire Planner
2.5.3	2.5.3.1	Number of prescribed burns started and, at some point during the burn, fell outside of smoke dispersal/air quality parameters	Annual Report	District FMO
2.6.1b 2.6.1c	2.6.1.1	Trends in closure of open roads	INFRA (annual)	District recreation manager
	2.6.1.3	Trends in seasonal closure of roads	INFRA (annual)	District recreation manager
2.7.3d	2.7.3.5	Trend in collaboration with local communities on defensible space and use of fire	Annual Report	District FMO

Monitoring Question 5a: Are projects being designed to achieve desired conditions of the management prescriptions?				
<i>Goal</i>	<i>Objective</i>	<i>Item(s) to be Measured</i>	<i>Frequency and method of reporting</i>	<i>Responsibility</i>
		Projects progressing toward management prescription conditions	2-3 year interval report	Planning Staff
Monitoring Question 5b: Are projects being implemented according to decisions in the NEPA process, including mitigating measures and plan standards?				
<i>Goal</i>	<i>Objective</i>	<i>Item(s) to be Measured</i>	<i>Frequency and method of reporting</i>	<i>Responsibility</i>
		Projects meeting plan standards	2-year interval report	Planning staff

5.4 Background Information for Monitoring

5.4.1 Baseline data for Monitoring Population Trends

RCW

Population Monitoring: The RCW monitoring program on CNF exceeds the requirements set forth in the USDA Forest Service's Final Environmental Impact Statement (1995, FEIS) for RCW on national forest lands in the Southern Region but is consistent with U.S. Fish and Wildlife Service's Revised Recovery Plan for RCW (2000, Draft). The Recovery Plan suggests Level IV monitoring for populations deemed essential to recovery and occurring on public lands. Level IV monitoring consists of color-banding nestling and adult birds, conducting nest checks at 7-11 day intervals, and conducting fledgling and adult checks to determine number and sex of birds. Level IV monitoring may be conducted on a sample of active clusters (IVa) or on all active clusters (IVb) as has been done on CNF for the past 10 years.

The RCW FEIS requires that all clusters be surveyed annually for activity status and that only a sample of clusters be monitored annually for nesting success and group composition. However, the Recovery Plan states that monitoring methods should not be mixed from year to year and that color-banding birds will be necessary when and if translocations are used as a management tool. Furthermore, the Recovery Plan states that due to sampling error, "...intensive monitoring of a sample of groups (Level IVa) can provide reliable estimates of productivity within a short period, but cannot estimate population trend until used for a longer period of time (e.g., 5 years)" and that "Accuracy of population trend assessment is also dependent on sample size... Thus, small samples cannot detect anything but large-scale changes in populations trends." Therefore, continued use of Level IVb monitoring on CNF will provide consistency and the most accurate population information. However, should the CNF population become too large for Forest Service staff to conduct 100% population monitoring, then statistically sound sampling methods can be implemented to monitor a subset of the population.

Population Dynamics: Several variables are important for monitoring population dynamics including number of active clusters, number of potential breeding pairs, proportion of solitary males, and average group size. An active cluster is defined as one that has evidence of RCW

activity including presence of active sap wells, fresh wood chips in one or more cavities, and birds observed in the vicinity of the cavity trees. A potential breeding pair is defined as a male and female pair of adult RCWs residing in an active cluster. Both are measures of population size, indicating number of potential RCW groups and size of the breeding population, respectively.

In general, the number of both active clusters and potential breeding pairs began to increase in 1991 following implementation of Walters management plan (Table 5.2). These numbers continued to increase each year from 2 % to 8 % peaking in 1996. The population subsequently suffered a net loss of activity at two clusters per year (3 %) from 1997 through 1999. However, the population experienced a 6.5 % increase from 1999 to 2000 that included the formation of two entirely new clusters. One of the new clusters was artificially created and the other was a result of territorial budding. The number of active clusters remained the same from 2000 to 2001. However, one recruitment cluster was occupied by a solitary bird post-breeding season. This cluster will not be considered active unless it remains active through the 2002 breeding season. The CNF breeding population experienced a net increase of one breeding pair in 2001.

The CNF has been within the normal range of reproductive values (Table 5.3). The proportion of groups that did not attempt a nest has, for the most part, remained below 10%. Annual mean clutch size has been around 3 eggs per nest (range 2.98 – 3.48), and the mean number of young produced has been around 1.5 per group (range 1.31 – 1.83). Furthermore, partial brood reduction has primarily remained at or below the average of 40% loss.

Analysis indicates that CNF currently supports a viable population of RCWs. The viability of this population is dependent upon the continued use of prescribed burning within RCW territories to control hardwoods and promote an understory of native grasses and forbs. It is also dependent upon maintaining an adequate number of suitable cavities for roosting and nesting.

Table 5.2. Population parameters, 1990-2001

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Active Clusters	44	50	53	54	57	59	64	62	60	58	62	62
Potential Breeding Pairs	36	43	47	49	52	53	55	50	48	45	52	53
% Solitary Males	9.1	8.0	9.4	3.7	5.3	8.5	9.4	12.9	10.0	6.9	9.7	9.8
Avg. Group Size	2.69	2.44	2.53	2.55	2.58	2.64	2.47	2.42	2.31	2.36	2.54	2.62
# Adults	111	125	133	135	151	165	158	139	137	121	142	144

The data indicates that the RCW population trend on the Croatan National Forest is increasing. After reaching a peak in 1996, the Croatan National Forest experienced a slight decline in numbers of active clusters and potential breeding pairs. The decline reversed in 2000, and the population trend continues to increase. Forest plan monitoring will continue over the next 10 years.

Plan expectations: By implementing the Plan it is expected that the number of new RCW clusters would increase by 2-3 each year. However, if the trend changes and the number of clusters begin to decrease and/or new clusters do not get established, the causal factors will be investigated and a plan amendment may be triggered.

Table 5.3. Reproductive parameters, 1990-2001

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Potential Breeding Pairs	36	43	47	49	52	53	55	50	48	45	52	53
% no nest	8	7	9	16	12	9	9	8	8	2	4	15
Clutch size	3.43	3.47	2.96	3.14	3.20	3.07	3.16	3.11	3.16	3.20	3.27	3.20
% fail	21	12.5	21	29	26	21	20	32.6	13.6	13.6	14	6.6
% renest	29	60	22	25	41.6	60	60	67	16.6	16.6	28.6	0
% Partial Brood loss	40	41	37	33	28	40	38	35	44	38	36	41
Brood size	2.06	1.98	1.78	1.82	1.96	1.81	1.86	1.73	1.73	1.98	2.06	1.85
Fledglings	52	72	62	64	84	76	85	74	63	78	95	79
Young/group	1.49	1.67	1.38	1.45	1.65	1.41	1.52	1.32	1.40	1.73	1.83	1.72

Longleaf/Wiregrass

Population Monitoring: The change in longleaf pine forest abundance, structure, and composition will be used to evaluate and adjust restoration and maintenance activities in these ecosystems on the CNF. The current abundance of longleaf pine forests was determined from the Continuous Inventory of Stand Condition (CISC) database. Periodic updates of this data base following field inventories will be used to determine the change in longleaf pine forest abundance on the CNF during Plan implementation.

The structure and composition of understory plants was measured at permanent monitoring plots from a random sample of pine stands in 2001. Plot data has been entered into a database. Additional permanent monitoring plots will be installed yearly, and measurements will be added to the existing database. Several plots will be established in areas that have pine straw harvesting proposed. A portion of the monitoring plots will be repeated at approximately 3-year intervals. The change in understory structure and composition in longleaf pine stands during plan implementation can be determined by evaluating data from repeated sampling.

Population Dynamics: Current abundance, structure, and composition in pine stands on the CNF are summarized in Tables 5.4a and 5.4b for land within and outside the RCW HMA and within and outside areas currently managed using prescribed fire (burn units). The data are stratified into these categories to facilitate comparison between areas having different management objectives and possibly different management intensities and results. These data are also available summarized by ecological type (potential natural vegetation, soil drainage, and soil texture). The data are stratified into these categories because inherent site capabilities and limitations strongly influence management outcomes. Evaluating the change in longleaf pine

forest abundance, structure, and composition within ecological types will allow managers to fine tune management activities to better-fit site capabilities found on the CNF.

The data available for longleaf indicate that a large amount of acreage exists with potential for restoration to longleaf pine. A small portion of this acreage is currently outside of prescribed burning units, which indicates restoration to longleaf may be more difficult due to the inability to apply fire. The data available for wiregrass indicate that the areas within burn units and the RCW HMA have a higher percent of wiregrass than areas not in burn units. The occurrence of small shrubs in conjunction with wiregrass is an interesting indicator that will be examined more closely with additional monitoring plots and repeated sampling.

Plan expectations: The number of acres of longleaf should increase. In conjunction with the number of acres of longleaf pine increasing, the percent of wiregrass within the RCW HMA should also increase due to lower impact restoration techniques and increased prescribed fire. The percent cover of small shrubs, tall shrubs and cane should decrease with more application of fire. However, the sites with higher percent cover of species other than wiregrass is thought to be due to soil type, and not necessarily directly related to the amount of prescribed fire applied to the area.

Table 5.4a: Current and potential longleaf pine forests (acres) within and outside the RCW Habitat Management Area (HMA) on the CNF.

Vegetation Type	Within RCW HMA			Not In RCW HMA
	Territories with Active Clusters	Territories with Recruitment Clusters	Not Currently in Burn unit	Not Currently in Burn unit
Longleaf pine Forests ¹	5,108	5,806	1,364	352
Longleaf pine potential	3,267	9,205	3,580	604

¹from Continuous Inventory of Stand Condition (CISC) data base (does not include 263 acres of longleaf pine not in RCW HMA but within a burn unit)

Table 5.4b: Number of samples (n), average cover percent, and (95% confidence range) for understory and midstory plants from a random sample of pine stands within and outside the RCW Habitat Management Area (HMA) on the CNF in 2001.

Vegetation Strata	Within RCW HMA			Not In RCW HMA
	Territories with Active Clusters	Territories with Recruitment Clusters	Not Currently in Burn unit	Not Currently in Burn unit
sample size	23	24	4	4
Wiregrass	16 (10-21)	8 (3-13)	2 (0-5)	1 (0-1)
Small shrubs ¹	41 (32-51)	31 (23-38)	36 (23-50)	58 (54-61)
Tall shrubs ²	7 (3-10)	13 (7-19)	30 (11-60)	45 (10-79)
Cane+ ³	5 (2-9)	4 (2-7)	16 (0-44)	1 (0-1)

¹ small shrubs are ≤ 1.5 meters in height

² tall shrubs are > 1.5 meters in height

³ giant cane and other grasses

Wild Turkey

Population monitoring: The North Carolina Wildlife Resources Commission tracts wild turkey populations annually. Using data collected by NCWRC, the Forest Service can use the information to estimate trends in response to active management. Wild turkey populations are divided into regions – Mountain, Piedmont and Coastal. Observational data, summer brood surveys, and harvest reports provide information in regard to population status by area and for the State. Wild turkey observations made by Commission personnel and/or other cooperators were recorded and tabulated statewide. Cooperators statewide conducted the 2000 wild turkey summer brood survey. Summer brood surveys are conducted each year during July and August. This information provides a wild turkey productivity index for the various regions of the State.

Table 5.5 Historical Summer Brood Survey Results, 1988-2000

Year	Total Turkeys Observed	Average Poult/Hen Ratios			
		Coast	Piedmont	Mountain	State
1988	662	3.5	2.6	6.2	5.5
1989	1,486	2.1	4.2	4.1	3.5
1990	1,259	2.8	4.9	3.2	3.6
1991	2,021	3.6	5.1	4.8	4.3
1992	1,218	2.7	1.5	1.8	2.0
1993	2,485	4.0	3.5	4.6	4.2
1994	3,473	2.8	3.8	3.3	3.3
1995	4,259	3.6	2.9	2.4	2.6
1996	5,418	3.0	3.3	2.4	2.7
1997	5,746	3.0	2.6	1.6	2.1
1998	9,289	2.8	3.7	3.5	3.5
1999	8,450	3.1	3.0	2.5	2.7
2000	11,599	3.2	3.1	2.8	3.0

Population Dynamics: Wild turkey productivity varied only slightly between geographical regions (Table 5.5). All three geographical regions experienced good nesting success (70%, 69%, and 73% of the hens were with poults in the coastal, piedmont, and mountain regions respectively). The coastal and piedmont regions experienced good poult survival (both with 4.6 poults/brood) and very good overall productivity (3.2 and 3.1 poults/hen respectively). The wild turkey population in the State is currently on an upward trend. This can be measured in several ways, particularly in harvest. Table 5.6 depicts the statewide historical wild turkey harvest for 1991-2001. Populations and harvests in the Coastal Region are steadily increasing. Intensified restoration efforts in this region in recent years should accelerate both population growth and harvest increases in the future.

Plan expectations: By implementing the Plan it is expected that the trend in the wild turkey population should continue to increase due to restoring upland hardwoods and protecting hardwood cypress wetlands. However, it is important to note that wild turkey habitat provided on the Croatan National Forest is only a portion of the overall habitat provided in the coastal area that supports the population. Activities such as hunting seasons, number of hunters, successful reproduction, and changes in harvest levels, are also decisions outside of US Forest Service control, which can affect population trends.

Table 5.6 depicts the historical wild turkey harvest data for the last ten years. Table 5.5 presents the age structure of the harvest by region and shows the percentage of juvenile birds in the harvest. Percentage of juvenile birds in the harvest is an indicator of the reproductive success from the previous year.

Table 5.6. Statewide Historical Wild Turkey Harvest, 1991-2001.

Year	Harvest	% Change from Previous Year
1991	1,818	-
1992	2,225	+22.4
1993	2,073	-6.8
1994	2,515	+21.3
1995	2,650	+5.4
1996	2,559	-3.4
1997	2,890	+12.9
1998	4,250	+47.1
1999	5,340	+25.6
2000	6,827	+27.8
2001	8,417	+23.3

Table 5.7 Historical Reported Wild Turkey Harvest in Carteret, Craven and Jones Counties, 1978-1999

Year	Counties			Total
	Carteret	Craven	Jones	
1978	0	1	0	1
1979	0	0	0	0
1980	0	0	0	0
1981	0	0	0	0
1982	1	0	0	1
1983	0	1	1	2
1984	0	0	1	1
1985	2	0	1	3
1986	1	0	1	2
1987	0	0	2	2
1988	0	0	1	1
1989	0	0	0	0
1990	0	3	0	3
1991	0	1	0	1
1992	2	9	0	11
1993	1	12	0	13
1994	2	17	0	19
1995	5	13	0	18
1996	7	28	15	50
1997	4	20	43	67
1998	5	25	61	91
1999	4	47	60	111
2000	4	60	73	137
2001	3	73	98	174

Black Bear

Population monitoring: The North Carolina Wildlife Resources Commission tracts black bear populations annually. Using data collected by NCWRC, the Forest Service can use the information to estimate trends in response to active management. Black bear populations are divided into regions based on counties. The Croatan National Forest falls into District 2.

The black bear populations are monitored through harvest data, mortality data, and are supplemented with nuisance complaints. Nuisance complaints are not useful indicators of actual bear population trends due to increasing human populations and increasing homebuilding in rural areas. However, the nuisance complaint trends do demonstrate ‘cultural carrying capacity’ or the population level with which local people can or will peacefully co-exist with bears.

Population Dynamics: Bear harvest in Coastal North Carolina was fairly stable until 1986. Since 1986, seasons have been established in 14 counties in the northeastern section of the state. The last of these counties opened in 1995. From 1991-1994, harvest was fairly stable in eastern NC. Three additional days were added to the season in 1995 in order to provide additional opportunity for hunters and to slow population growth in some areas where populations appeared to be approaching “cultural carrying capacity”. In 1999, the northeastern season was expanded to an 18-day season. The current emphasis is on monitoring the stability of the harvest. Population models indicate that the Coastal Region’s bear population may be stabilizing following increased harvests in the last 4 years (Table 5.8). The harvests of 929 in 2000-2001, 881 in 1999-2000, and 879 in 1998-1999, respectively, are the highest harvests ever reported. The harvest levels for counties that contain the Croatan National Forest have progressively increased over the last 14 years, indicating an increasing population trend (Table 5.9).

Observed mortalities of black bears are those documented by NCWRC biologists and represent all known mortalities due to vehicles, depredation, illegal kills, and unknown causes (Table 5.10). Of observed mortalities, 111 of 749 (14.8%) were caused by non-harvest factors. Vehicle mortalities accounted for 5.6% (n=89) of total known mortality (n=1601) in 2000 while prior to 1999, vehicles accounted for an average of 9-11% of total mortality. On the Coast, road kills accounted for 67 mortalities in 2000. This number is below average (n=73) for Coastal roadkills over the last 5 years with 67 bears killed by vehicles in 1995, 47 in 1996, 93 in 1997, 95 in 1998, and 63 in 1999. The opening of new seasons and an increase in season length may account for some bears that might otherwise die in vehicle-related accidents.

Reproductive information was obtained from 73 females in 2000 on the Coast (Table 5.11). The average ovulation incidences of 2.21 for 5+ year-old females on the Coast are comparable to previous good years. In 1999, a high percentage of 2.75 year-old bears showed breeding activity in the Coastal region of the state (100%). In 2000, sample sizes were lower but only 50% of 2.75 year-old bears showed breeding activity in the Coastal region. In addition, 62.5% of Coastal 3 year-olds had placental scars indicating implantation of a fertilized egg. These young ages of first breeding and reproduction have a tremendous positive impact on the population dynamics of black bears and may partially explain the population increase seen on the Coast over the last decade. Black Bear populations are well established in most suitable habitat on the Coast.

Plan expectations: The trend in the black bear population should continue to increase due to maintenance of contiguous habitat, decreases in road density, and providing soft mast. However, it is important to note that black bear habitat provided on the Croatan National Forest is only a portion of the overall habitat provided in the coastal area that supports the population. Activities such as hunting seasons, number of hunters, successful reproduction, and changes in harvest levels, are also decisions outside of US Forest Service control, which can affect population trends.”

Table 5.8 Historical Summer Brood Survey Results, 1988-2000

Year	Number of bear harvested
2000-2001	929
1999-2000	881
1998-1999	879

Table 5.9 Reported Black Bear Harvest in Carteret, Craven and Jones Counties, 1976-1999

Year	Counties			Total
	Carteret	Craven	Jones	
1976	0	ns	7	7
1977	5	ns	14	19
1978	8	ns	8	16
1979	6	ns	9	15
1980	6	ns	9	15
1981	10	ns	6	16
1982	13	ns	ns	13
1983	9	ns	16	25
1984	7	ns	23	30
1985	11	ns	14	25
1986	18	ns	17	35
1987	7	ns	11	18
1988	8	ns	25	33
1989	12	23	24	59
1990	18	14	40	72
1991	18	18	35	71
1992	21	13	37	71
1993	23	23	31	77
1994	16	24	43	83
1995	21	39	58	118
1996	16	26	42	84
1997	10	26	80	116
1998	12	37	85	134
1999	18	53	73	144
2000	29	45	65	139

Table 5.10. Observed Black Bear Mortality in District 2, 2000.

Cause of Mortality						
County	Hunting	Vehicle	Depredation	Illegal	Other	Total
Beaufort	34	15	0	0	0	49
Carteret	1	0	0	0	0	1
Craven	14	2	0	0	0	16
Duplin	2	3	0	0	0	5
Lenoir	0	1	0	0	0	1
New Hanover	0	1	0	0	0	1
Jones	29	6	0	0	0	35
Onslow	21	1	0	0	0	22
Pamlico	13	0	0	0	0	13
Pender	5	7	0	0	0	12
Pitt	0	0	0	1	0	1
Total	119	36	0	1	0	156

Table 5.11. Coastal Region Black Bear Reproductive Performance by Age Class, 2000.

Age (Years + $\frac{3}{4}$)	n	Percent Ovulating	Ovulation Incidence ^a	Percent w/ Placental Scars	Percent w/ Placental Scars & CL
1	10	0.0	N/A	0.0	0.0
2	6	50.0	1.33	0.0	0.0
3	8	50.0	1.75	62.5	12.5
4	11	36.4	2.25	81.8	18.2
5+	38	36.8	2.21	76.3	18.4
Total	73				

^aDerived from females that ovulated

5.4.2 Background Information for Monitoring Habitats

The CNF Plan proposes active management in predominantly 5 Ecological Classification System Landtypes. Within these landtypes and associated management prescriptions, individual species are monitored to measure effects (Management Indicator Species). The remaining 3 Landtypes either have no management activities proposed or the management activities are limited in amount and distribution to only have minor, localized effects. To better gauge the effects from management, these landtypes (i.e. habitats) will be monitored for change due to management activities.

The landtypes that will be monitored are lake and stream swamps, tidal streams and estuaries, and maritime ridges and dunes. These landtypes correspond to the hardwood cypress wetland and pocosin lake management prescriptions.

Aquatic habitat: Aquatic habitats are monitored on the Croatan through a joint effort with the North Carolina Division of Marine Fisheries, North Carolina Wildlife Resources Commission (NCWRC), NC State University, Forest Service personnel, and other state agencies. An aquatic classification was developed for the CNF Plan to guide both regional planning as well as displaying the range of ecological types across a landscape. Using the biological and habitat

inventory information developed at reference sites can be used to extrapolate to uninventoried sites at other locations (Appendix H). Fourteen aquatic ecological types were identified. These ecological types are the basis for monitoring aquatic habitats, and are designated by number in the following discussion.

Currently, large tidal rivers (2), tidally influenced sections of large creeks (3), large acidic natural lakes (7), and acidic and nonacidic ponds (8&9) are monitored cooperatively with the NCWRC. Monitoring non-tidal midreaches of large streams (4) is challenging due to the difficulty in gaining access.

The approach to monitoring aquatic habitats begins by taking the spatial data for the 11 aquatic ecological types and seeing how and where they occur on the Forest. For the most part, all of the aquatic ecological types (i.e. habitats) can be monitored using several key water quality parameters (e.g. salinity, pH, dissolved oxygen, conductivity). These data are cost effective to collect, and reliable indicators.

Historic fish data exists from across the Croatan National Forest that can be associated with each habitat type, and therefore associate any changes in fish community based on changes in water quality (i.e. habitat). Trend data are being developed for large rivers and ponds/lakes on the Forest. However, it will be several more years until a reliable data set is available.

Another aquatic habitat monitoring element is the utilization of Forest waters by anadromous species. The year 2002 is the 3rd year of data collection on the first 3-year assessment (eels and striped bass). The next 3-year assessment will analyze “bait fish”, such as mullet.

Due to the difficulty in obtaining accurate or reliable data, several aquatic ecological types are not considered in the monitoring plan. These include acidic and nonacidic upper reaches of large streams, estuarine branches and creeks. The pocosin and dense forest vegetation, as well as swampy lowlands have too much hydrologic connectivity to capture fish with any reliability and without the use of piscicides, which is not a desired action.

Terrestrial Habitat (least affected landtypes) – To monitor the hardwood cypress wetland management prescription (which include landtypes maritime ridges and dunes, and lake and stream swamps), these areas will be inventoried and mapped for old growth conditions. Portions of these areas are also included in the breeding bird survey routes, which is part of the Regional Landbird Conservation Strategy that helps to measure health of the overall system. On the Croatan National Forest, only 4 locations totaling 45 acres exist of the maritime ridge and dune forest landtype. However, this landtype is common outside the Forest. Ten acres of this landtype is proposed for restoration on the Croatan. Plots will be established in restoration areas to measure success.

Using data collected from the breeding bird surveys conducted across the state, population estimates and trends may be established at the state and regional scale. Two routes for breeding bird surveys are used on the Croatan National Forest, the Newport Route and Broad Creek Route (Tables 5.12 and 5.13). Information for statewide trends indicates positive trends for both the prothonotary warbler and pileated woodpecker at rates of +2.5% and +1.5% respectively.

Between 1966 and 1979, the prothonotary warbler and pileated woodpecker had positive trends of +9.8% and +5.2% respectively. Between 1980 and 1999, the prothonotary warbler had a +1.7% trend. However, during the same years, the pileated woodpecker had a negative trend of -0.9%. The prairie warbler did not have adequate data for reliable trend estimation. However, based on data available indications are that statewide overall the trend is down by -1.8%, with the time between 1966 and 1979 showing a -11.5% trend. The years between 1980 and 1999, however, showed an upswing in the trend by +0.6%.

Although the population trends for neotropical migratory birds are an important issue, the Forest Service only has control over part of the habitat (hardwood cypress wetlands). The Plan proposes few, low impact and relatively infrequent activities that would affect the habitat. A larger area than the CNF would be needed to determine meaningful population levels and trends. Monitoring the habitat of neotropical migratory birds, by inventorying and mapping the old growth condition found within the habitat, is more useful for managers since it monitors the condition of landtypes least affected by management activities, but checks that habitats are progressing toward desired conditions.

To evaluate the effectiveness of management and the level of human disturbance within Natural Areas, the conditions of element occurrences will be measured and element occurrence records will be updated. The presence, absence, or reappearance of element occurrences, can be used to indicate the level of, and effects from, human disturbances. Several objectives propose management and protection of Natural Areas, such as inclusion during prescribed burning, exclusion from salvage activities, and consideration of allowing natural processes to function. By monitoring the condition of element occurrences within the Natural Areas, the effectiveness of management and protection activities can be gauged.”

<i>Table 5.12 Breeding Bird Survey, Broad Creek Route</i>			
Year	Number of Birds Recorded		
	<i>Prothonotary Warbler</i>	<i>Prairie Warbler</i>	<i>Pileated Woodpecker</i>
1993	8	19	4
1994	12	3	3
1995	6	4	4
1996	4	7	0
1997	5	12	4
1998	6	11	2
1999	14	14	4
2000	8	9	6

<i>Table 5.13 Breeding Bird Survey, Newport Route</i>			
Year	Number of Birds Recorded		
	<i>Prothonotary Warbler</i>	<i>Prairie Warbler</i>	<i>Pileated Woodpecker</i>
1995	4	2	1
1996	7	12	0
1997	4	11	0
1998	6	2	3
1999	5	12	2

5.4.3 Background Information for Monitoring Public Use and Customer Satisfaction

The CNF Plan outlines a strategy for managing the public use of the Croatan National Forest in a way that meets the needs and desires of the public, while ensuring the natural resources are sustained. The Plan strives to meet the desires and needs of local communities, visitors, residents and the economy. It also strives to change past uses that are currently not being provided in a sustainable manner.

The monitoring question for this category functions to measure whether the opportunities being provided are sustainable, satisfactory, safe, and desirable. This question also requires measures to determine whether the changes proposed to current management are solving the problems identified during the planning process.

In 1998 a recreation sampling system was developed by research and forest staff that would be cost effective and provide statistical recreation use information at the forest, regional and national level. The NVUM project is the permanent sampling protocol that was developed and implemented nationally to gauge the importance of, and satisfaction with, recreational opportunities within the national forest system. The NVUM is administered once every four years on every national forest in the country. The National Forests in North Carolina participated in the National Visitor Use Monitoring project (NVUM) from October 2000 through September 2001. The results collected are valid and applicable only at the forest level, and not intended to be accurate at the district or site level (NVUM Report June 2002). The sampling results can therefore not be applied specifically to the Croatan National Forest. To answer what and how much people are doing on the Croatan National Forest, and to what extent they are enjoying the experience, information needs to be collected that is specific to the CNF.

Using the sampling protocol as the NVUM utilized, information will be collected for the Croatan National Forest sometime between 2002 and 2006, when the next scheduled sampling will occur for all the National Forests in North Carolina. Questions that pertain specifically to the CNF will be developed to focus the results on answering the monitoring question. It will be vitally important to ensure statistically accurate and useful data is collected. To do this the preliminary sample design, sampling unit selection, sample size and variability, and survey implementation must be developed in coordination with District, Forest and Research input.

The Plan outlines several recreational projects to increase capacity of recreational facilities and trail miles, in addition to focusing recreational activities on wildlife and fishing interests. Collecting additional information through a localized NVUM project will help to validate the assumptions made during the planning process that the public's interest in recreation was hunting, picnicking, swimming, and included a desire for increased trail miles and a variety of facilities ranging from rustic to developed (Appendix B of FEIS outlines the perception of recreation needs during the planning process.). The NVUM results for the National Forests in North Carolina for the top 10 recreational activities and top 10 facility/area uses indicate some consistency between the assumptions made during the planning process and the data collected (Table 5.14).

Table 5.14 Percentage of Participation and Use of the top 10 Activities/Top 10 Facilities based on NVUM results for National Forests in North Carolina

Activity	Percentage of Participation
1. Viewing natural features such as scenery, flowers, etc	70.3
2. General/other – relaxing, hanging out, escaping noise or heat	49.7
3. Viewing wildlife, birds, fish, etc	48.2
4. Hiking or walking	46.0
5. Driving for pleasure	41.0
6. Picnicking and family day gatherings in developed sites	20.0
7. Fishing- all types	19.1
8. Nature Study	14.3
9. Visiting a nature center, nature trail or visitor info services	13.1
10. Primitive camping	10.7
Facility	Percentage of Use
1. Hiking, biking, horseback trails	55.0
2. Scenic byway	46.5
3. Picnic area	29.0
4. Visitor center, museum	28.6
5. Other forest road	23.6
6. Interpretive site	15.1
7. Developed campground	13.1
8. Designated wilderness	8.4
9. Swimming area	4.5
10. Designated Off Road Vehicle area	4.2

Visitor satisfaction of facilities will be measured to gauge not only what is or isn't satisfactory, but also what is important to their recreational experience. Grouping these responses helps to prioritize limited resources based on what is important but may not be satisfactory, rather than expending resources on unsatisfactory but also unimportant aspects of the recreational experience.

Using the science based survey format, a survey will be conducted on the Croatan National Forest within 5 years of implementation of the Plan, and alternating with the national survey cycle of once every four years. Questions that pertain specifically to the CNF will be developed to focus the results on answering this monitoring question. The Plan outlines several recreational projects to increase capacity of recreational facilities and trail miles, in addition to focusing recreational activities on wildlife and fishing interests. Collecting additional information through the survey will help to validate the assumptions made during the planning process that the public's interest in recreation was water-based and included the need for increased trail miles and a variety of facilities ranging from rustic to developed (Appendix B of FEIS outlines the perception of recreation needs during the planning process.).

5.4.4 Background Information for Local Communities

Collaboration with other government agencies and local communities has occurred informally over the last 10-15 years. Statistics for baseline information are not available at this time. The planned expectations are more frequent collaborative efforts in the future.

References

- Anderson, Hal E., 1982. Aids to determining fuel models for estimating fire behavior. General Technical Report INT-22. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, 22 pp.
- Arthur Carhart National Wilderness Training Center. 2002. Minimum Requirement Decision Guide [Online] <http://carhart.wilderness.net>.
- Ash, A.N.; McDonald, C.B.; Kane, E.S.; Pories, C.A. 1983. Natural and modified pocosins; literature synthesis and management option. FWS/OBS-83/04. Washington, D.C.: U.S. Department of Interior Fish and Wildlife Service, Division of Biological Services, 156 pp.
- Brown, J.H.; Heske, E.J. 1990. Control of a desert-grassland transition by a keystone rodent guild. *Science*. 250(4988):1705-1707.
- Conner, R.N.; Rudolph, D.C. 1995. Excavation dynamics and use patterns of red-cockaded woodpecker cavities: relationships with cooperative breeding. In: RED-COCKADED WOODPECKER RECOVERY, ECOLOGY, AND MANAGEMENT, Center for Applied Studies, College of Forestry, Stephen F. Austin State University.
- Dickson, J.G.; Williamson, J.H.; Conner, R.N.; Ortego, B. 1995. Streamside zones and breeding birds in eastern Texas. *Wildlife Society Bulletin*. 23(4):750-755.
- Davis, M.D. 1996. Extent and Location: Chapter 2. In: Davis, M. D., ed., EASTERN OLD GROWTH FORESTS. Washington, D.C.: Island Press: pp. 18-34.
- Dunning, J.B.; Danielson, B.J.; Bulliam, H.R. 1992. Ecological processes that affect populations in complex landscapes. *Oikos*. 65: 6 pp. Federal Wildland Fire Management Policy and Program Review, Draft Report, June 9, 1995. U.S. Department of Interior, U.S. Department of Agriculture.
- Ferguson, Joe. Air quality and prescribed fire course for the future. Unpublished draft on file: Tallahassee, FL: National Forests in Florida.
- Forman, R.T.; Godron, M. 1986. LANDSCAPE ECOLOGY. New York: John Wiley & Sons. 619 pp.
- Frost, C.C. 1993. Four centuries of changing landscape patterns in the longleaf pine ecosystem. In: Proceedings of the Tall Timbers Fire Ecology Conference, No.18. 25 pp.
- Frost, C.C. 1995. Presettlement vegetation and natural fire regimes of the Croatan National Forest. Prior conditions documentation prepared for the Croatan National Forest, U.S. Forest Service, New Bern, N.C. November 30, 1995 (unpublished).
- Frost, C.C. 1996. Presettlement vegetation and natural fire regimes of the Croatan National Forest. North Carolina Department of Agriculture, Plant Conservation Program. 128 pp.
- Frost, C.C.; Walker J.; Peet R.K. 1986. Fire-dependent savannas and prairies of the southeast: original extent, preservation status and management problems. In: Kulhavy, D.L. and Conner, R.N., eds. WILDERNESS AND NATURAL AREAS IN THE EASTERN UNITED STATES. Nacogdoches, TX: Center for Applied Studies, School of Forestry, Stephen F. Austin State University.
- Fussell, J.O.; Wilson, J. (Kraus) 1980. Natural areas inventory of Carteret County, North Carolina. Report prepared for the North Carolina Natural Heritage Program. Coastal Energy Impact Program, Office of Coastal Management, DNRCD, Raleigh, NC.
- Healy, W. H. 1991. Trends in management of oak forest for wild turkeys. In: Conference proceedings, oak resource in Upper Midwest-implications for management: 45-55.

- Hellgren, E.C.; Vaughan, M.R.. 1988. Seasonal food habits of black bears in Great Dismal Swamp, Virginia and North Carolina. *Proceedings, Annual Conference Southeast Association Fish and Wildlife Agencies*. 42:295-305.
- Hamel, P.B. 1992. *LAND MANAGER'S GUIDE TO THE BIRDS OF THE SOUTH*. Chapel Hill, NC: The Nature Conservancy, Southeastern Region. 437 pp.
- Hillman, L.L.; Yow, D.L.. 1986. Timber management for black bear. *Proceedings, Eastern workshop bear research and management*.
- Hooper, R.G. 1988. Longleaf Pines Used for Cavity Trees by Red-Cockaded Woodpeckers. *Journal of Wildlife Management*. p. 7.
- Hungerford, Roger D.; Frandsen, William H.; Ryan, Kevin C. 1995. Ignition and burning characteristics of organic soils. In Cerulean, Susan I.; Engstrom, R. Todd eds. *Fire in wetlands; a management perspective*. *Proceedings of the Tall Timbers Fire Ecology Conference*, No. 19. Tall Timbers Research Station, Tallahassee, FL. 78-91.
- Hughes, R.H. 1966. Fire ecology of canebrakes. In: *Proceedings of the Tall Timbers Fire Ecology Conference*, No. 5. Tallahassee, FL: Tall Timbers Research Station. 149-157.
- Hunter, C. 1997. South Atlantic coastal plain bird conservation plan. Unpublished draft on file: Atlanta, GA.
- Hunter, M. 1991. Coping with ignorance: The Coarse-Filter Strategy for Maintaining Biodiversity. Pp. 256-281 K.A. Kohm, ed., *BALANCING ON THE BRINK OF EXTINCTION THE ENDANGERED SPECIES ACT AND LESSONS FOR THE FUTURE*. Island Press, Washington, D.C.
- Jackson, J.A. 1977. Red-cockaded woodpeckers and pine red heart disease. *Auk* 94: 3 p.
- Jackson, J.A.; and Jackson, B.J.S. 1986. Why do red-cockaded woodpeckers need old trees? *Wildlife Society Bulletin*. 14: 6 p.
- Jenkins, R.E. 1976. Maintenance of Natural Diversity: Approach and Recommendations. Pp. 441-451 *Transactions of the 41st North American Wildlife Conference*, 4 March 1976, Washington, D.C. Wildlife Management Institute, Washington, D.C.
- Jenkins, R.E. 1985. Information methods: Why the Heritage Programs work. *The Nature Conservancy News* 35(6):21-23.
- Keller, C.M.; Robbins, C.S.; Hatfield, J.S. 1993. Avian communities in riparian forests of different widths in Maryland and Delaware. *Wetlands* 13: 37-144.
- Kelley, J.F.; Bechtold, W.A. 1990. The Longleaf Pine Resource. In: *Proceedings of the Symposium on the Management of Longleaf Pine*. Gen. Tech. Rep. SO-75. Starkville, MS: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 11 pp.
- Korschgen, L.J. 1967. Feeding habits and foods. In: Hewitt, O.H. (ed.) *THE WILD TURKEY AND ITS MANAGEMENT*. Washington, D.C.: Wildlife Society. pp. 137-198.
- Landers, Larry; Wade, Dale. 1993. Disturbance, persistence and diversity of the longleaf pine-bunch-grass ecosystem. A paper presented at the Fire Working Group Technical Session at the Society of American Foresters National Convention. Indianapolis, IN. November 7-10, 1993.
- Landers, J.L., Hamilton, R.J.; Johnson, A.S.; Marchinton, R. L. 1979. Foods and habitat of black bears in southeastern North Carolina. *Journal of Wildlife Management*. 43:143-153.
- Lavdas, L. G. 1996. Program USMOKE — Users Manual. General Technical Report SRS-6. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 147 pp.

- Ligon, J.D. 1970. Behavior and breeding biology of the red-cockaded woodpecker. *Suk* 87. p. 23.
- Lillard, R.G. 1947. *THE GREAT FOREST*. New York: Alfred A. Knopf.
- Long, Ellen Call. 1990. Forest fire in southern pines. *Forest Leaves*. 2 (6):94.
- Maehr, D.S. 1984. Distribution of Black Bears in Eastern North America. *BLACK BEAR RESEARCH AND MANAGEMENT*. 7: 74-75.
- MCAS Cherry Point. "Mission and History". [Online] August 13, 2002.
<http://www.cherrypoint.usmc.mil>
- McGarigal, K.; Marks, B.J. 1995. FRAGSTATS: spatial pattern analysis program of quantifying landscape structure. General Technical Report PNW-GTR-351. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 122 p.
- Mixon, R.B.; Pilkey, O.H. 1976. Reconnaissance geology of the submerged and emerged coastal plain province, Cape Lookout area, North Carolina. Geological Survey Professional paper. 859.
- National Commission on Wildfire Disasters Report, 1993. Printing supported by American Forests.
- 1990 Census of Population and Housing, North Carolina.
- National Wildfire Coordinating Group Incident Operation Incident Operations Standards Working Team, 1996. Glossary of Wildland Terminology. Boise, ID: National Interagency Fire Center.
- The Nature Conservancy. 2000. Biological Conservation Database.
- N.C. Dept Environment, Health and Natural Resources. 1990. Best Management Practices for Forestry in the Wetlands of North Carolina.
- North Carolina. 1989. Forest Practice Guidelines Related to Water Quality. North Carolina Administrative Code 15A NCAC 11 .0100-.0209.
- Noss, R.F. 1987. From plant communities to landscapes in conservation inventories: A look at The Nature Conservancy (USA). *Biological Conservation*, 41:11-37.
- Pelton, M.R. 1986. Habitat needs of black bears in the East. In: Kulhavy, D.L.; Conner, R.N. (des.) *WILDERNESS AND NATURAL AREAS IN THE EASTERN UNITED STATES: A MANAGEMENT CHALLENGE*. Nacogdoches, TX: Stephen F. Austin State University. 49-53.
- Ranney, J.W.; Bruner, M.C.; Levenson, J.B. 1981. The importance of edge in the structure and dynamics of forest islands. In: Burgess, R.L.; Sharpe, D.M., eds. *FOREST ISLAND DYNAMICS IN MAN-DOMINATED LANDSCAPES*. New York: Springer-Verlag: 26 pp.
- Rudis, V.A.; Tansey, J.B. 1985. Regional assessment of remote forests and black bear habitat from forest resource surveys. *Journal Of Wildlife Management*. 59(1): 170-180.
- Rural Fire Protection in America, 1992. Rural Fire Protection in America Steering Committee, U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. Radnor, PA.
- Schafale, M.P.; Weakley, A.S. 1990. Classification of the natural communities of North Carolina. Third Approximation. Raleigh: North Carolina. Natural Heritage Program.
- Strelke, W.K.; Dickson, J.G. 1980. Effect of forest clearcut edge on breeding birds in Texas. *Journal of Wildlife Management*. 44: 8 pp.
- Trapani, Elena. "Seasonal Variations in Surface Water Chemistry and Fire Effects on a Pocosin Lake: Great Lake in Croatan National Forest, North Carolina" Masters Thesis. East Carolina University. 1998.

- U.S. Department of Agriculture, Forest Service. 1989. Position statement on national forests old-growth values. Unnumbered internal memo to regional foresters, station directors, and Washington Office staff, October 11, 1989. Unpublished draft on file: Washington, DC.
- USDA, Forest Service, 1997. Guidance for conserving and restoring old growth forest communities on national forests in the southern region. Forestry Report R8-FR 62. p. 124.
- Van Lear, David H.; Waldrop, Thomas A., 1985. Current practices and recent advances in prescribed burning. Clemson, SC: Clemson University, Department of Forestry. 14 pp.
- Walters, R.J. 1997. Population and management studies of red-cockaded woodpecker on Croatan National Forest, 1988-1997 (internal report). USFS National Forests in North Carolina. 25 p.
- Williams, Jerry T., 1994. Fire's role in support of ecosystem management. A paper presented at the Biswell Symposium. Walnut Creek, CA. February 15-17, 1994.
- Wilson, L.A. 1995. LAND MANAGER'S GUIDE TO THE AMPHIBIANS AND REPTILES OF THE SOUTH. Chapel Hill, NC: The Nature Conservancy, southeastern region. 360 pp.
- Weigl, P.D., Steele, M.A.; Sherman, L.J.; Ha, J.C.; Sharpe, T.S. 1989. The ecology of the fox squirrel (*Sciurus niger*) in North Carolina; implications for survival in the Southeast. Tall Timber Resource Stat. Bulletin. No. 24. 93 p.
- Wergowski, D. 1995. Evaluation of ambient airborne particulate matter concentrations in the Southern Appalachian assessment — with implications for forest land management. Unpublished draft on file: Atlanta, GA: U.S. Department of Agriculture, Forest Service, Region 8.